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IMPERIAL INSTITUTE OF ENTOMOLOGY

FARNHAM HOUSE LABORATORY

The war has reduced the opportunities for work based on Farnham House. Dr. Thompson, the Superintendent of the Laboratory, is now stationed at the Dominion Parasite Laboratory, Belleville, Ontario, Canada, where the Canadian Government has provided quarters and facilities for his work and that of his staff on the biological control of insect and plant pests. His senior assistant, Mr. E. Cameron, remains in the United Kingdom available for such work as can be done in that country.

Work on the natural enemies of animal and plant pests can now be undertaken in the temperate, subtropical and tropical regions of the Western Hemisphere. Entomologists in the countries of the British Commonwealth of Nations who wish to avail themselves of this opportunity for an extension of their biological control work are asked to communicate with Dr. W. R. Thompson, F.R.S., Imperial Parasite Service, Imperial Institute of Entomology, 228, Dundas Street, Belleville, Ontario, Canada, giving a detailed statement of their requirements.

Those who require parasites normally obtainable in the United Kingdom are asked to send their requests with similar details to The Director, Imperial Institute of Entomology, British Museum (Natural History), Cromwell Road, London, S.W.7, England.

Such division of orders should save time, but the parasites required will be obtained from whichever source is the more convenient or more promising. Dr. Thompson remains as Superintendent and in general charge.

IMPERIAL INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES A.

VOL. 29. 1941.

CHAPMAN (P. J.). **Insect Pest Problems of Importance to the Fruit Industry in 1939.**—*Proc. N. Y. St. hort. Soc.* **85** pp. 12–31, 1 map, 1 graph, 3 refs. Le Roy, N. Y., 1940.

In 1939 the codling moth [*Cydia pomonella*, L.] was particularly abundant in the Hudson Valley. It was also an important pest on apple in western New York, but probably not more so than in the three preceding seasons. Records are given of the mean temperature in May–August in the Hudson Valley and the fruit districts of western New York for each year from 1920 to 1939, and of the average summer rainfall in these areas for the period 1929–39 as a whole, together with evidence that increased infestation by *C. pomonella* is associated with a warm summer, which can completely offset the effect of a severe winter. In most seasons temperatures were below normal (about 66°F.) during 1920–29, when the moth attracted little attention, and above normal during the next ten years, when it has been an important pest. It is, however, usually more important in western New York than in the slightly warmer Hudson Valley; this is explained by the normally heavier summer rainfall in the latter area. The summer of 1939 was the driest for over 20 years in the Valley and the warmest since 1880. Other factors that have contributed to the increased severity of infestation in New York State during the past decade include continuous plantings of orchards, their increased age, and, apparently, the development of a strain of the moth resistant to insecticides. The advantages and drawbacks of spray schedules in which a summer-oil emulsion and nicotine preparations are substituted for lead arsenate are discussed.

A severe outbreak of the rosy apple Aphid [*Anuraphis roseus*, Baker] occurred in western New York in 1939. The failure to control it by dormant or delayed-dormant sprays is attributed to inadequate spraying methods, applying the sprays too early or too late, or during cold, windy and rainy weather, and the use of inferior spray mixtures [*cf. R.A.E.*, A **28** 283]. A table is given showing the composition of various early-season apple sprays used for the control of the Aphid and their effectiveness against other pests, *viz.*, the bud moth [*Argyroploce variegana*, Hb.], San José scale [*Aspidiotus perniciosus*,

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Comst.], leaf-roller [*Tortrix argyrospila*, Wlk.], European red mite [*Paratetranychus pilosus*, C. & F.], and red bug [*Lygidea mendax*, Reut.].

CHAPMAN (P. J.). **Codling Moth Problems in the Hudson Valley.**—*Proc. N.Y. St. hort. Soc.* **85** pp. 295–302. Le Roy, N.Y., 1940.

A tabular summary is given of the answers by apple growers to a questionnaire regarding the causes of the unusually severe outbreak of the codling moth [*Cydia pomonella*, L.] in the Hudson Valley in 1939. The chief causes are believed to be the very hot and dry weather [see preceding paper] and inadequate spraying. In general, second-brood sprays were omitted, because they are not usually required in this area, and the amount of spray applied per tree was insufficient because the primary object was the control of apple scab. If *C. pomonella* is abundant, it is necessary to apply at least 20 U.S. gals. of spray per mature tree and to cover the fruit completely with a uniform coating of the insecticide. The concentrated planting of orchards in certain areas assisted the building up of the population of the moth; this population gradually increased during 1936–38, as the summer temperatures in those years were considerably above normal. Spray programmes for 1940 are suggested that include substitutes for lead arsenate in the later applications to avoid the need for washing the apples, which has never been required in the Hudson Valley.

RITCHER (P. O.), VALLEAU (W. D.) & MAGILL (W. W.). **Fruit Pests and their Control.**—*Bull. Kentucky agric. Exp. Sta.* no. 393 pp. 121–179, 20 figs. Lexington, Ky, 1939. [Recd. 1940.]

This bulletin on the commoner pests and diseases of fruit crops in Kentucky is largely concerned with insects. Notes are given on the life-histories and control of those attacking apple, peach, cherry, grape-vine and strawberry, together with spray schedules for apple, peach, cherry, vines and currants, and gooseberries. Some general information on spray materials and their application is appended.

BAERG (W. J.), ISELY (D.) & SANDERSON (M. [W.]). **Entomology.**—*Bull. Arkansas agric. Exp. Sta.* no. 368 (Rep. 1937–38) pp. 62–66, 1 fig. Fayetteville, Ark., 1938. [Recd. 1940.]

Damage to seedling maize by adults of the Dynastid, *Euetheola rugiceps*, Lec., increased in Arkansas in 1938, owing partly to heavy rainfall during spring and early summer, partly to the extension, especially in the north-east, of land cropped with maize, and partly to the practice of strip cropping, in which the grass strips provide a source of infestation that in one case was sufficient to destroy half the stand of maize. Maize is attacked chiefly during May and the first week of June and is susceptible to injury until it is knee-high; if the infested plants survive, they become bushy and do not produce ears. To avoid infestation, maize should not be planted on low-lying wet land [*cf. R.A.E.*, A **25** 623] or near grass plots containing, in particular, Bermuda grass [*Cynodon dactylon*] or Johnson grass [*Sorghum*].

The cotton aphis [*Aphis gossypii*, Glov.] becomes of economic importance only on cotton that has received successive applications

of calcium arsenate dust for the control of the boll weevil [*Anthonomus grandis*, Boh.] and the cotton leafworm [*Alabama argillacea*, Hb.]; the arsenical apparently destroys the Hymenopterous parasites of the Aphid and outbreaks of the latter are therefore most frequent in late summer. Under experimental conditions, the rate of reproduction was highest at about 70°F.; the greatest amount of reproduction for a single day occurred at 75°F., and the Aphids lived longest at 66°F. They suck the plant juices, sometimes causing the leaves to fall, and produce quantities of honey-dew, on which a sooty fungus develops. If the honey-dew falls in opening bolls, the lint becomes discoloured, while many of the young bolls that become covered with it fall before they open.

BAERG (W. J.), ISELY (D.) & SANDERSON (M. W.). **Entomology.**—*Bull. Arkansas agric. Exp. Sta.* no. 386 (Rep. 1938–39) pp. 63–68. Fayetteville, Ark., 1940.

Euetheola rugiceps, Lec., continued to be of major importance on seedling maize in Arkansas in 1939. Recommended preventive measures [*cf. R.A.E.*, A **27** 178] include the planting of oats and cotton in rotation with maize, and thorough and frequent cultivation, as long as the size of the maize permits, to eliminate grasses on land that has been planted with maize for a number of years in succession, especially where the land has lain fallow or been under sod for some time before planting.

In this State, the cotton bollworm [*Heliothis armigera*, Hb.] does not cause extensive injury to cotton bolls, soy beans and grain *Sorghum* or very serious injury to maize until the larvae of the third generation hatch [*cf.* **24** 295], generally during the last week in July. Further studies on the differential grasshopper [*Melanoplus differentialis*, Thos.] confirmed previous findings that cotton is an unsuitable food-plant for this species, whereas soy bean is a favourable one [**28** 170]. The average durations of the nymphal stage of males and females reared on soy beans at mean temperatures of 26–28°C. [78·8–82·4°F.] were 74 and 81 days, respectively. On reaching the adult stage, they were transferred to cotton, on which the average longevity was only 16·5 days; females lived for 6–59 days, but none oviposited.

Four species of *Cyclocephala* occur in Arkansas, of which *C. immaculata*, Ol., is the most abundant, constituting about a quarter of the total white-grub population. Laboratory-reared adults of this Dynastid lived for as long as 23 days, during which they were not observed to feed. Eggs laid by laboratory-reared females hatched in 12–17 days; the mean duration of the egg stage was 15·11 days at 25°C. [77°F.] and 13·50 days at 26°C. Most of the larvae in the field occurred at depths of 3–5 ins. below the soil surface.

TUCKER (R. W. E.). **Introduction of Dry Area Race of *Metagonystylum minense* into Barbados.**—*Agric. J. Barbados* **8** no. 4 pp. 113–131, 4 refs. Barbados, 1939. [Recd. 1940.]

The measure employed for the control of *Diatraea saccharalis*, F., on sugar-cane in Barbados is the large-scale liberation of the egg parasite, *Trichogramma minutum*, Riley, but it is hoped that this may be supplemented by the establishment of imported parasites of the larvae. Introductions of *Lixophaga diatraeae*, Tns., in 1930 and

1934–35 [*R.A.E.*, A **20** 612 ; **25** 42, etc.] were unsuccessful, and no attempt has been made to introduce the riparian (Amazon) strain of *Metagonistylum minense*, Tns., in view of its failure to become established in Antigua [**27** 183] and Porto Rico [**28** 651], where conditions resemble those in Barbados more closely than do those in British Guiana and St. Lucia, where its establishment has been successful [**26** 491 ; **27** 182]. The discovery of the melanic strain of *M. minense* in the dry area of São Paulo [**26** 82], where the annual rainfall approximates to that in Barbados, led to efforts to establish this strain in 1939, and a detailed account of the work is given in this paper.

Nearly 200 puparia of *M. minense* were collected in São Paulo during April 1939, and from these a stock of puparia free from hyperparasites was reared for shipment to Barbados. The percentage parasitism among larvae of *D. saccharalis* in São Paulo was 15·8, of which about 25 per cent. was probably due to *Theresia claripalpis*, Wulp (*Paratheresia diatraeae*, Brèthes) and the rest to *M. minense* ; about 35–40 per cent. of the larvae were too small to be parasitised. An adequate supply of adults was expected from the puparia of *Metagonistylum* within 6–7 days, but, probably owing to early winter conditions, emergence was extremely slow, averaging one adult per day. The first 15 to emerge were males ; a female appeared on the 17th day, and 7 days later the minimum number of mated females required (6 or 7) had been obtained. The gestation period was also extended from 6–7 to 10–11 days. From these females a total of 190 puparia free from hyperparasites were reared and, in addition, 70 puparia of *M. minense* and 23 of *T. claripalpis* were obtained from field-parasitised larvae of *D. saccharalis*. The puparia were sent to Barbados, chiefly by air, in order that the journey might be completed within the pupal period (7–8 days).

A further supply of parasites was collected in Minas Geraes, where there were relatively few small larvae of *D. saccharalis* and the degree of parasitism was 29·6 per cent. Lack of time prevented the rearing of a stock, but 158 field-collected puparia of *Metagonistylum* and 109 of *Theresia* were sent to Barbados. They were subjected to cold storage in transit, and the adults of *Metagonistylum* obtained would not mate, so that the strain could not be reared in Barbados. It is, however, probably not distinct from the melanic São Paulo strain. Careful precautions, which are described, were taken in Barbados to prevent the escape of hyperparasites from field-collected puparia.

In addition to the melanic strain of *M. minense* from Brazil, a few mated females of the same strain and of the Amazon strain originally imported from British Guiana were obtained from Porto Rico, and 35 field-collected puparia of the Amazon strain from British Guiana were imported from St. Lucia. These strains were reared, the São Paulo strain from Brazil was crossed with each of the strains obtained from Porto Rico and St. Lucia, and the Amazon strains from Porto Rico and St. Lucia were also intercrossed. Adults of the São Paulo strain crossed with those of the St. Lucia-Amazon strain produced the most vigorous individuals of any strain or cross. The Amazon strain appeared to be more robust and fecund than the São Paulo strain, from which it also differs in coloration, but there is considerable individual variation within both strains.

Owing to prolonged drought, most of the *Diatraea* material obtained for inoculation in Barbados was in the pupal or larval diapause stages.

Larvae in diapause pupated before the parasite larvae could enter or could develop sufficiently to prevent them from doing so, and the number of adults raised from each inoculation was therefore very small; during July, the highest percentage recovery (number of puparia per 100 host larvae inoculated) was 104·5, only 14 per cent. being obtained in some cases. In later inoculations, larvae in diapause were discarded, the larvae employed were dipped in saline solution before inoculation to facilitate penetration, the number of parasite larvae placed on each was increased from 2–3 to 3–4, and more host larvae from maize were available. Under these conditions, the lowest percentage recovery was 92 and the highest 175·5; an average of 92·6 per cent. was obtained during the period 1st July–22nd December. The females are oviparous, but the larvae hatch almost immediately after the eggs are deposited; after preliminary experiments, the females were dissected 10 days after fertilisation. The adults were protected from the effects of the prolonged drought by covering the cages with two layers of wet sacking. A total of 23,779 adults were reared in 1939, of which 61 per cent. were males. Rearing was to be continued during 1940.

In normal years, the cane has grown sufficiently to provide shelter and host material for *M. minense* by June, but, owing to the drought, conditions were not favourable until October in 1939. Liberations were made in varying environments throughout Barbados, generally in fields of plant cane. Each colony comprised 40–50 mated females and 12 or more males, since a preponderance of males appears to be necessary in this species. In all, 7,559 mated females of all strains and crosses and 3,495 males were released during 1939, but no recoveries were made in field collections, and only three examples were found among many thousands of bored shoots and canes examined up to the end of December. It is therefore considered unlikely that this parasite will become established [*cf.* **28** 246]. The annual rainfall in São Paulo is believed to be approximately the same as that in Barbados (50–70 ins.), but the cool dry season in the former coincides with the hot wet season in the latter, and there are other differences that may collectively be unfavourable for permanent establishment even if the initial colonisation proves to be successful. The most important of these are the absence of alternative shelter and food-plants of *D. saccharalis* and the prevalent high winds during the 2–4 months after reaping and before the new crop has grown enough to provide suitable conditions, when the populations of both parasite and host will be at a minimum as a result of reaping.

T. claripalpis proved difficult to rear owing to a reluctance to mate under laboratory conditions, and as it was found impossible to devote much attention to it, the final stock of 4 females and 11 males was liberated in September. Both adults and puparia of *T. claripalpis* were more robust than those of *M. minense*, and the puparia were less easily damaged and less frequently attacked by parasites, but the natural rate of parasitism by it was much lower both in São Paulo and Minas Geraes.

TUCKER (R. W. E.). **The Termites of Barbados.**—*Agric. J. Barbados* **8** no. 4 pp. 132–144, 2 refs. Barbados, 1939. [Recd. 1940.]

Recent investigations have shown that at least seven species of termites occur in Barbados. These are *Calotermes* (*Cryptotermes*)

brevis, Wlk., *Coptotermes havilandi*, Hlmgr. [*R.A.E.*, A **28** 414], and *Heterotermes tenuis*, Hag., which attack timber in buildings; *Eutermes* (*Nasutitermes*) *costalis*, Hlmgr., which attacks sugar-cane; and three or more species of *Calotermes*, possibly undescribed, which belong to the subgenera *Neotermes*, *Calotermes* and *Cryptotermes*. Members of the first two of these subgenera attack trees in Bridgetown, and there are single records of *Neotermes* sp. and *E. costalis* from buildings. *Coptotermes havilandi* is an Asiatic species that also occurs in Mauritius, but had not previously been recorded from the New World. Shipments of wallaba wood [*Eperua falcata*] are regularly imported from British Guiana and used as firewood throughout Barbados; on examination they were found to contain *Coptotermes testaceus*, L., *E.* (*N.*) *octopilis*, Banks, and *Termes hispaniolae*, Banks, none of which has previously been reported in Barbados. Usually, workers and soldiers only, in surface runs, were found, but a queen and nymphs of *T. hispaniolae* also occurred. Since wood has been imported regularly for many years, it is considered unlikely that these species will now become established in Barbados. A species of *Coptotermes* tentatively determined as *C. havilandi* was also obtained from shipments of wallaba wood, and may therefore represent a hitherto unrecognised element in the fauna of British Guiana.

Of the termites that damage buildings, *C. havilandi* occurs only at Bridgetown but is very injurious, and *H. tenuis* is more widespread but causes less injury. Both are subterranean termites and enter buildings by means of covered runways or through cracks in cement floors, but they sometimes make nests in ceiling beams to which they have gained access by penetrating up the interior of the walls, which are made of coral lumps or rubble. The dry-wood termite, *Calotermes brevis*, enters as winged adults; faecal pellets occur in, and fall from, wood infested by it. Control measures include the destruction of nests in buildings by pouring into them "sanitary oil" (a cheap, non-inflammable petroleum distillate used to control flies and mosquitos) or petrol where sanitary oil might be injurious; boring holes in infested timber and blowing dry Paris green into the termite galleries; breaking open severely infested timber and spraying it with oil or dusting it with Paris green as a temporary measure until it can be replaced by sound termite-proof wood; and breaking termite trails and dusting them with dry Paris green.

Damage to sugar-cane by *E. costalis* is of variable economic importance. In badly infested fields, growth may be patchy where the seed-pieces have been destroyed, or the plants in areas of varying size may wither and dry up after growing normally for a time if immature shoots or mature canes have been killed. The latter type of injury is also characteristic in wind-swept fields after prolonged drought; when it is due to termites the cane becomes green after heavy rains, but the presence of dead canes and others partly destroyed, particularly at the base, becomes apparent when the cane is reaped. This damage is sometimes attributed to *Diaprepes abbreviatus*, L., and *Lachnosterna smithi*, Arr. Of 76 fields examined, all but 6 were infested, and the infestation in 13 involved 20–50 per cent. of the stools and would cause a loss of 3–5 per cent. of the total crop. Control consists in destroying nests in the cane-fields soon after reaping, and, periodically, those in neighbouring woods, mostly small plantations of mahogany, and in ravines and gullies. The nests are black dome-shaped carton structures, mainly above the surface but sometimes

extending several inches into the soil. They are destroyed by piercing them in several places and pouring in about 2 pints of sanitary oil, which field observations have shown to be sufficient to destroy all the termites present, including the queen, although it may not come in contact with them. Where nests occur in strips of *Cajanus cajan* (*indicus*) planted round cane-fields, the use of oil may not be desirable, and the nests or trails are then opened and the termites dusted with Paris green. *E. costalis* also damages trees in gardens and attacks outdoor wooden structures. The damage is mostly to badly pruned or broken limbs that have not been painted or tarred and to broken limbs on the ground, but living portions of trees, especially *Plumeria* sp., are sometimes destroyed.

Observation of infested timber indicates that British Guiana greenheart [*Nectandra rodioei*], wallaba and mahogany are the most resistant, although they are not immune ; even hardwoods may be attacked, especially when sapwood is present. Increasing use is being made of greenheart and other hardwood timber for building purposes. As a result of an experiment in which pieces of wood treated with five commercial preparations were left for five months near a nest of *E. costalis*, two that afforded complete protection are recommended ; another test, in the absence of termites, showed them to be good preservatives. It is also suggested that wood for internal use that is to be painted or polished can be proofed by treatment with a solution containing 5 per cent. zinc chloride in water ; and that creosote is of value on outdoor woodwork that is not to be painted. For effective treatment, an even layer of preservative must be applied to all surfaces, including cut ends and edges, to present an unbroken surface of wood well soaked by the preservative. The incorporation of metal courses in the foundations of newly constructed buildings does not yet appear to be necessary in Barbados.

TUCKER (R. W. E.). *Bufo marinus* **L. in Barbados.**—*Agric. J. Barbados* **8** no. 4 pp. 145–150, 2 refs. Barbados, 1939. [Recd. 1940.]

The following is largely based on the author's summary : The giant toad, *Bufo marinus*, has been established in Barbados for over 100 years, and has become the most important predator of insect pests of sugar-cane, particularly *Diaprepes abbreviatus*, L., and *Lachnosterna smithi*, Arr. Of recent years, however, its numbers have been seriously limited by the lack of breeding places and shelter resulting from drainage and intensive cultivation and by the destruction of the tadpoles by Dytiscid larvae.

Observations during 1936–39 have shown that broods of *B. marinus* can be raised in an artificial cement pool only 7–18 ins. deep, provided that Dytiscids are controlled by netting and crushing the larvae and adults, or by emptying the pool, if the water becomes turbid, and removing and drying the rocks provided for shelter and as a resting place for the toads. Better results are obtained, however, in large deep pools in which abundant shelter is provided by water lilies. *B. marinus* is generally present in pools that are weeded and stocked with fish to control mosquito larvae, but heavy mortality results from the practices of draining the ponds, or of oiling the surface, in compliance with mosquito control regulations. Broods were raised in every month, but the main breeding period is in the wet, warm

months of June and July and coincides with the seasonal peak incidence of adults of *D. abbreviatus* and *L. smithi*. The eggs generally hatch after 3–4 days and metamorphosis is complete and the toads ready to disperse 23–24 days later, but there are minor seasonal variations in the length of the developmental period.

The construction on estates of artificial pools in which the toads can breed is recommended, but they should not be near natural ponds and should be so situated that they can be readily replenished with water in dry weather. Where bee-hives are attacked by the toads, they should be raised at least 2 ft. from the ground or enclosed by an adequate fence; the toads can climb over a wire mesh fence 2½ ft. high and with a slightly curved top.

GALLEGO (F. L.). **Una nueva plaga en nuestros cultivos de plátano y un posible enemigo para la caña de azúcar.** [A new Pest in our Plantations of Banana and a possible Enemy of Sugar-cane.]—*Rev. Fac. nac. Agron.* (*Colombia*) **2** no. 4–5 pp. 377-385, 5 pls. (1 col.). Medellín, 1940.

Descriptions are given of all stages of a Castniid tentatively identified as *Castnia atymnius* race *humboldti*, Boisd., which has recently caused serious injury to banana in Colombia by mining in the underground parts of the rhizomes and the shoots from them. The eggs are present throughout the year, but are commonest in June–September. They are laid singly, chiefly at the base of the pseudostem, and hatch in 18–26 days. The larvae bore downwards, or occasionally also upwards, for distances of about 2 ft. The larval stage does not exceed 9 months, and the pupal stage, which is passed in the soil close to the food-plant, lasts 20–26 days. The adults survive only a few days, and females deposit 30–40 eggs. The larvae were also observed tunnelling in sugar-cane in one field, generally upwards from the base of the canes. As sugar-cane is commonly grown near banana, it is feared that this moth may become a serious pest of the former.

MURILLO (L. M.). **Un insectario para la cría y multiplicación de la *Apanteles thurberiae* Mues.** [A Cage for breeding and multiplying *A. thurberiae*.]—*Rev. Fac. nac. Agron.* (*Colombia*) **2** no. 4–5 pp. 386–392, 2 figs. Medellín, 1940.

An account is given of the laboratory technique that has been developed in Colombia for breeding *Apanteles thurberiae*, Mues., the Braconid parasite of the cotton bollworm, *Sacadodes pyralis*, Dyar [*cf. R.A.E.*, A **26** 403]. A cotton boll was placed in a cage and its stem allowed to protrude through the floor into a glass tube containing a nutritive solution. Eggs of *S. pyralis* were placed on the boll, and when the larvae hatched, an adult of each sex (or a fertilised female) of *A. thurberiae* was introduced. For breeding on a large scale, a cage was used that accommodated 100 bolls, 500 eggs of *S. pyralis* and 10 females of the Braconid.

VERANO (A.). *Rhynchophorus palmarum* **L.**—*Rev. Fac. nac. Agron.* (*Colombia*) **2** no. 4–5 pp. 393–408, 3 pls., 6 refs. Medellín, 1940.

An account is given of the distribution and bionomics of *Rhynchophorus palmarum*, L., in Colombia, where the larvae cause considerable

damage by boring in coconut and other palms, and also attack papaya, sugar-cane and *Gynerium saccharoides*. All stages of this weevil are described. In the laboratory, females deposited up to 40–50 eggs, and the egg and pupal stages lasted 3½–4 and 17–18 days; the larval stage is thought to last more than a year. The weevils are attracted to small pieces of freshly cut palm, sugar-cane or, particularly, papaya, which can be used as traps. They retain their attractiveness for up to a week and should then be burnt to destroy any eggs or larvae in them. Pieces of papaya stem, which are more attractive than piles of cane trash, are especially suitable for use in sugar-cane fields. Fair results were given by placing them over vessels containing water, 32 weevils being caught in one such trap in 6 days. Preventive measures include the treatment of all wounds in susceptible plants, clean cultivation and mounding the soil round the base to prevent oviposition, especially in palms.

Llanos (V. V.). **La** *Trichogramma minutum* **Riley en Colombia.** [*T. minutum* in Colombia.]—*Rev. Fac. nac. Agron.* (*Colombia*) **2** no. 4–5 pp. 409–410. Medellín, 1940.

In Colombia, *Trichogramma minutum*, Riley, was reared from eggs of *Diatraea saccharalis*, F., on sugar-cane in 1936, taken in a cotton area in 1937, and observed in 1939 together with *Telenomus dilophonotae*, Cam., parasitising the eggs of *Erinnyis ello*, L., which is a serious pest of cassava, but was, in this instance, effectively controlled by the two parasites. A million individuals of *T. minutum* were imported in 1939 from California and liberated in sugar-cane fields, but the result is not yet known. It is considered that there would be no difficulty in breeding *Trichogramma* in large numbers in the laboratory in Colombia, since *Sitotroga cerealella*, L., the usual laboratory host, is common throughout the country.

Bondar (G.). **Notas entomologicas da Bahia. V.**—*Rev. Ent.* **11** fasc. 1–2 pp. 199–214, 8 figs., 7 refs. Rio de Janeiro, 1940.

This part of a series on insect pests in Bahia [*cf. R.A.E.*, A **27** 566] deals with Lepidoptera and Coleoptera attacking coconut and other palms. Descriptions are given of the larvae of the Pyralids, *Hyalospila ptychis*, Dyar, and *Ephestia cautella*, Wlk., and the Tineid, *Batrachedra perobtusa*, Meyr., all of which attack the flowers. *H. ptychis* is one of the most important coconut pests in Bahia, though the injury it causes has not attracted attention. It feeds on the carpels of the female flowers, preventing the formation of the fruits, and also mines the mesocarp of the developing fruits, causing them to fall or become deformed. It also attacks *Cocos coronata*, *C. vagans*, *Attalea funifera* and *A. piassabossu*, and these palms are evidently its original food-plants. Its life-cycle is completed in 25–30 days. Larvae of *E. cautella*, which also completes its life-cycle in about a month, are common in the male and female flowers and the ripe fruits of *Cocos* and *Attalea*. In coconuts, they feed on the oleaginous substances in the mesocarp and in the kernels. They also damage stored coconuts and copra. Larvae of *B. perobtusa*, of which the life-cycle lasts 15–18 days, feed on the pollen of coconut and other species of *Cocos* and *Attalea*, rendering the palms sterile. Owing to the sheltered position of the larvae of these moths, sprays do not give complete

control. As arsenicals scorch the flowers, it is preferable to use sprays of nicotine or rotenone, or even Bordeaux mixture, the copper sulphate in which is toxic to the larvae. The destruction of native palms is advocated as a preventive measure.

The adults and larvae of the Cassidid, *Himatidium neivai*, sp.n., which are described, feed on the leaf buds and the young leaves of coconut, and cause considerable injury to fruits that are still green by destroying the epidermal tissues and exposing the mesocarp. They prefer sheltered situations and are often found where two fruits are in contact. They can be controlled by an arsenical spray or one of Bordeaux mixture and Paris green. *H. bondari*, Spaeth, and *H. bahianum*, Spaeth, which have similar habits and attack native palms of the genus *Geonoma*, are potential pests of coconut. The male flowers of *Cocos coronata* are injured by the weevils, *Ancylorrhynchus trapezicollis*, Hustache (MS.) and *Derelomus bondari*, Hustache (MS.), the adults of which feed on the pollen. Larvae of the latter, which also attacks coconut, fed on the anthers, becoming full-fed in 6–7 days, and pupated in the soil. The adults emerged in 17–18 days. The Nitidulid, *Mystrops palmarum*, sp.n., the adult and larva of which are described, has similar habits. It is very abundant on *C. coronata* and less so on coconut. The larval stage lasts 5–6 days and the complete life-cycle 10–12.

Snipes (B. T.). **Experiencias preliminares com arseniato de chumbo e arseniato de cálcio no combate ao curuquerê, *Alabama argillacea* (Hübn.) (Lep. Noctuidae).** [Preliminary Experiments with Lead Arsenate and Calcium Arsenate against *A. argillacea*.]—*Rev. Ent.* **11** fasc. 1–2 pp. 501–532, 7 figs., 13 refs. Rio de Janeiro, 1940. (With a Summary in English.)

A detailed account is given of the results of the first part of a series of field tests on the control of *Alabama argillacea*, Hb., on cotton at Viçosa, in the State of Minas Geraes. In this locality the chief attack on cotton usually occurs early in March, but may be as early as February or as late as May. The course of infestation from 1st January to 7th March 1939 was ascertained by daily examinations of 2,000 cotton plants, and by counts of the larvae on them. The percentage of plants infested was very low until 5th February, when it was 2·25, but rose on 6th February to 84·6, and on 18th February to 95. The number of larvae per 2,000 plants was highest (6,520) on 6th February, after which it decreased steadily until the end of the observation period. Owing to climatic factors and the sudden hatching of the larvae, which cannot be forecast, preventive measures are impracticable.

The technique and arrangement of the experiments are described in detail. The dusts used contained equal parts of lead or calcium arsenate and sulphur, and the sprays lead or calcium arsenate at rates of 5 and 2·5 lb. per 100 gals., with the addition of equal parts of lime to the latter and wheat flour to the former. All the treatments were more effective when applied in the morning, when the leaves are wet with dew and the larvae are more active. The best control (94·1 per cent. mortality in 24 hours) was given by the lead-arsenate dust, but the results given by calcium arsenate in the dust or the stronger spray were not statistically inferior. The stronger suspension of lead arsenate was less effective, and the weaker one unsatisfactory.

From these preliminary field tests and consideration of the availability of materials, convenience of application and cost, the measure recommended is the application of the stronger calcium-arsenate spray at the rate of about 45 gals. per acre between 4.30 and 8 a.m. when there is little or no wind. Treatment should be carried out when 5 per cent. of the plants are found to be infested.

WILLE (J. E.). **Observaciones sobre** *Heliothis virescens* **F. como plaga del algodonero en el Peru.** [Observations on *H. virescens*, F., as a Pest of Cotton in Peru.]—*Rev. Ent.* **11** fasc. 1–2 pp. 584–588, 8 refs. Rio de Janeiro, 1940.

The author points out that though *Heliothis virescens*, F., infests a number of plants, notably tobacco, in the United States [*R.A.E.*, A **15** 628, etc.], it has not been recorded as a pest of cotton there [but *cf.* **24** 522]. It has, however, been recorded on cotton in St. Croix (Virgin Islands) [**11** 513] as well as in South America. It first became of importance on cotton in Peru early in 1937 [*cf.* **27** 385], when infestation was severe in the north-west of the Cañete Valley. It spread over the whole valley in the following seasons [**28** 279] and to two neighbouring valleys to the south in 1939. It is considered that the outbreak is not due to definite ecological factors, since a similar one has been recorded in São Paulo, Brazil [**25** 590], where these are very different. Work on the control of the moth by means of trap plantings of chick pea [*Cicer arietinum*] is recapitulated [*cf.* **28** 279], but the spray applied to them against the larvae is stated to have contained twice as much lead arsenate and lime.

CARPENTER (J. R.). **Insect Outbreaks in Europe.**—*J. Anim. Ecol.* **9** no. 1 pp. 108–147, 11 figs., 3 pp. refs. London, 1940.

Though existing data on the actual numbers of insects present at given times are insufficient for the determination of trends in insect populations over long periods of years, the published records of insect outbreaks can be used as a rough measure of periods of abnormal abundance in certain species. In this paper, an attempt is made to bring together some of the data pertaining to recorded insect outbreaks in Europe in order to determine whether such outbreaks can be regarded as normal fluctuations in population numbers, when the individuals of all species of a large area are regarded as members of one population. In view of the lack of uniformity in the usage of the term " outbreak," it is defined for the purpose of this study as that time during the fluctuation cycle of a species when it is sufficiently abundant or injurious, or both, to warrant a record by observers.

The history of the recording of insect outbreaks and the systems officially adopted in several countries are reviewed, and the seven natural vegetation regions of Europe, including European Russia, in which the records are grouped for analysis, are briefly described. In the seven smaller regions into which the deciduous forest area, owing to its size and the large number of records from it, was divided, there was a strong tendency for insect outbreaks to be more numerous in certain years than in others or to occur nearer together than would be expected from chance. There was no definite periodicity in the recurrence of peak years of outbreak abundance, but the interval between them diminished from about 12 years in 1780 to about 6 years

in 1915, and a similar, but less definite diminution also occurred in the intervals between years of maximum migration of locusts. A comparison of the fluctuations characteristic of this region with those of the other biotic areas demonstrated that although certain trends are common to all, the fluctuation pattern is more or less different for each biotic area and is probably characteristic of it. The fluctuations of the population as a whole are not characterised by any individual species, and evidence of considerable disturbance of the biotic balance in years when the insect population is large is supplied by the change, either increase or decrease, in the numerical abundance of 16 species that are normally numerous for a prolonged period. The necessity for more objective measurements of sample populations, providing some estimation of the actual numbers and density of the individuals of each species, is stressed, and brief suggestions are put forward on methods whereby such studies might be achieved.

Theories concerning the factors that cause outbreaks are reviewed from the literature. They include the presence of pure stands of single plant species, climatic and other environmental factors, fluctuations in the physiological conditions of insects and food-plants, and biotic interaction, such as that between parasites and hosts, and predators and prey. Species within the same ecological niche may exhibit the same reaction, when the outbreak may be regarded as a phenomenon of the niche. It is suggested that the outbreak of one species may cause disturbances in the community that may generate similar outbreaks in other species. Disturbances due to invading species are discussed with reference to locusts.

Manninger (A. G.). **Adatok a lucernabimbógubacslégy** (*Contarinia medicaginis*) **biológiájához, különös tekintettel a lucernamagtermesztésre.** [The Biology and Control of the Lucerne Gall-midge.] —*Mezögazdas. kutatás.* **13** pt. 4 pp. 97–102, 3 figs., 6 refs. Budapest, 1940. (With a Summary in German.)

Investigations in 1939 on the life-history of *Contarinia medicaginis*, Kieff., on lucerne in Hungary showed that the first period of flight and oviposition must have occurred at the end of May, since the first galls were observed on 12th June. In breeding experiments, six further flight periods occurred, the last during 21st–25th August. The midges were by far the most numerous in the first two of them, in late June and early July. Newly hatched larvae gave rise to adults in 9–14 days, depending on temperature. In a comparative test, nearly 2½ times as many midges emerged from wet as from dry soil. The commonest parasite was the Miscogasterid, *Systasis encyrtoides*, Wlk., but species of *Pteromalus*, *Synopeas* and *Callimome* also occurred. The measures advised against this Cecidomyiid are the prevention of oviposition by repeated early mowings, advancing the date of the first mowing so as to avoid the flight periods, and capturing the adults by means of nets.

Hrisafi (C. P.). **Contribuţiuni la sistematica şi biologia coleopterului** *Galerucella luteola* **Müll.**—Demy 8vo, 85 pp., 7 pls., 49 figs., 6 graphs, 200 refs. Bucarest, 1940. (With a Summary in German.)

Most of the information in this paper on the life-history and habits of *Galerucella luteola*, Müll., on elm in Bucharest has been noticed

from a briefer account [*R.A.E.*, A **22** 557]. The adult morphology is described in detail, special attention being devoted to variations in coloration. Additional natural enemies of the Galerucid were the Tachinid, *Anachaetopsis nitidula*, Rond., which parasitised the larvae, and the larvae of Coccinellids and *Chrysopa* sp., which destroyed the eggs. Up to 74·5 per cent. of the eggs in the field were destroyed by natural enemies.

Soukhov (K. S.) & Vovk (A. M.). **Mosaic Disease of Oats.**—*C. R. Acad. Sci. URSS* (N.S.) **19** no. 3 pp. 207–210, 2 figs., 2 refs. Moscow, 1938. **Mosaic of cultivated Cereals and how it is communicated in Nature.**—*Op. cit.* **20** no. 9 pp. 745–748, 2 figs., 6 refs. 1938. [Recd. 1940.]

Sukhov (K. S.) & Sukhova (M. N.). **Interrelations between the Virus of a new Grain Mosaic Disease (Zakuklivanie) and its Carrier *Delphax striatella* Fallen.**—*Op. cit.* **26** no. 5 pp. 479–482, 11 refs. 1940.

Sukhov (K. S.) & Petlyuk (P. T.). ***Delphax striatella* Fallen as Vector of the Virus Disease Zakuklivanie in Grains.**—*T.c.* pp. 483–486, 2 refs.

In Siberia, cereals, particularly oats, are attacked by a disease known as zakuklivanie, which causes mosaic on the leaves and leaf sheaths, makes the plants dwarfed and bushy, and deforms the flowers, reducing or preventing the formation of grain. Of these symptoms, mosaic is the most general and is the first to appear, but may be inapparent in dry and hot weather. Investigations in Omsk in 1937, which are described in the first paper, showed that the disease is not transmitted by sap inoculation or through the soil, but is probably carried by sucking insects. In experiments in the following summer, an account of which is given in the second paper, it was transmitted from infected oats to healthy oat seedlings by adults or nymphs of the Delphacid, *Delphacodes* (*Delphax*) *striatellus*, Fall., but not by the Jassids, *Macrosteles* (*Cicadula*) *sexnotata*, Fall., and *Laevicephalus* (*Deltocephalus*) *striatus*, L. It was also transmitted by *Delphacodes striatellus* from oats to barley and millet, and from barley to oats. Its presence in the field was detected in barley, millet, rye, maize, and, apparently, wheat.

Further experiments with *D. striatellus*, carried out in 1939, are described in the third paper. When the insects were reared on uninfected oats they did not cause the disease, which showed that it is due to a virus and not to a toxin injected in the process of feeding. When, however, young nymphs were placed on infected oats and later on healthy ones, about 30 per cent. of them proved to be infective. The incubation period in the insects varied from 6 to 24 days, so that their rate of infectivity increased with each instar, and reached its maximum in the adult stage. It never exceeded 37 per cent., however, under field experimental conditions, which implies that some individuals are immune from infection. Infection was acquired most readily by nymphs in the first and second instars and hardly ever by fifth-instar nymphs or adults. It was acquired slowly ; nymphs had to be on infected plants for 2–3 days for a maximum rate of infection. On the other hand, transmission to healthy oats was effected

easily and often in 5–10 minutes. The virus does not multiply in the insects, so that in time they lost the power of infecting healthy oats, and it was not transmitted by nymphs that were the offspring of infected females but had themselves been fed only on healthy plants.

The percentage of the insects infected in nature varied with the infection of the plants on which they were taken ; it was 30–37 on early sown oats, of which all were infected, 8·5 on late-sown oats, of which 25 per cent. were, and only about 4 per cent. on rye, which, in general, is much less subject to the disease. It appears that the virus hibernates to a large extent in the nymphs, as when overwintered individuals were taken on dry oat stubble where there was no vegetation on which they could have fed, 20·3 per cent. proved to be infective.

It was observed that the resistance of the plants to infection increases with their age ; those that are not infected before they have five or six leaves are not stunted, though mosaic appears on the leaves and some of the spikes become deformed. The virus was found in two annual weeds, *Panicum crus-galli* and *Setaria viridis*, the latter being very susceptible and very attractive to *D. striatellus*, and occasionally in perennial grasses (*Agropyrum repens* and *Bromus inermis*). Under experimental conditions, it could be transmitted to rice, but not to soy beans.

The fourth paper deals with the bionomics of *D. striatellus* as observed near Omsk in 1939. The nymphs overwintered, chiefly among grasses, etc., on uncultivated strips or at the edges of meadows, and began to be active in mid-April. The adults, which first appeared on 23rd May, flew to oats, barley and, occasionally, wheat. They usually flew about 3 ft. above the ground and in the direction of the wind. A field of oats was protected from infestation and consequent infection with the virus by a gauze fence about 6 ft. high, whereas unprotected oats were infected to the extent of 17 per cent. It appears, therefore, that live hedges round fields would be of value. Crops sown after 20th May practically escaped infestation, though later, owing to the development of the first generation of the Delphacid, the percentage infection of late sown oats increased from 3–10 to 15–25. Eggs are laid in batches of 3–4 in the tissue of the leaves and in the leaf-sheath. Under experimental conditions one female gave rise to more than 200 nymphs. In June, the eggs hatched in 9–10 days and the nymphal stage lasted 20–25 days. The first-generation adults began to appear on 26th June (when some of the overwintered generation were still alive) and migrated in large numbers from early oats, barley and wheat to late-sown oats and millet, on which they oviposited and the second-generation nymphs appeared by August. After harvest, these nymphs remained for some time on the stubble and then made their way to grass and *Setaria*. With the onset of cold weather, the nymphs in the fourth instar, and some of those in the third, entered hibernation, but the other nymphs and adults perished.

The only natural enemies observed were Coccinellid larvae and the Dryinid, *Pristogonatopus conjunctus*, Kieff., which parasitised 2·4 and 18–25 per cent. of the nymphs of the overwintered and first generations, respectively. The most effective method of control would be to destroy the hibernating nymphs concentrated on narrow strips of ground overgrown with weeds, on which an insecticide that scorched the plants would not be disadvantageous.

Nesterenko (P. A.) & Zaritsky (S. N.). **"Hollowness" in Clary Sage** (*Salvia sclarea* **L.**).—*C. R. Acad. Sci. URSS* (N.S.) **20** no. 9 pp. 741–744, 3 figs. Moscow, 1938. [Recd. 1940.]

Considerable loss has been caused during the last 5 or 6 years to growers of clary (*Salvia sclarea*) in the Crimea, where this plant is cultivated for its essential oil, by a condition known as hollowness of the roots. The plant is normally perennial, but has been so weakened that no yield of flowers is obtained after the second year. Affected plants show large hollow formations near the root-crown, which cause exhaustion and death. Investigations carried out in a greenhouse and in the field in 1936–38 showed that the larvae of the weevil, *Phrydiuchus topiarius*, Germ., are responsible for the injury. In tests in which cuttings from healthy plants were allowed to root in a greenhouse, the percentage of plants subsequently observed to be infested ranged from 15 to 47; of old plants in a botanical garden examined in the spring of 1938, 61 per cent. were infested, 3–16 larvae often occurring together in one plant, especially in the young flower-bearing shoots. Observations showed that eggs are deposited in autumn in the rosette of shoots of plants sown in the preceding November, and the young larvae burrow into the underground part, in which they hibernate. Pupation takes place in the soil in May. The mines, which are small, have little affect on flowering during the first season. During the following year, however, they are invaded by fungi and bacteria, which cause rupture of the vessels of the root system and kill the plants; death is probably accelerated by the formation of ice in the hollows, which destroys the root crown. Very often the young flower-bearing shoots are alone infested and ultimately die away without having produced flowers; no central hollows are formed in such plants.

Zazhurilo (V. K.) & Sitnikova (G. M.). **Mosaic of Winter Wheat.**—*C. R. Acad. Sci. URSS* (N.S.) **25** no. 9 pp. 798–801, 2 figs., 5 refs. Moscow, 1939. **Mosaic of Spring Cereals in the Voronezh District.**—*Op. cit.* **26** no. 5 pp. 474–478, 2 figs., 6 refs. 1940.

In the first paper, it is stated that a mosaic disease of autumn-sown wheat has recently been recorded from a number of Provinces in European Russia, particularly from Voronezh, where 15–20 per cent. of the plants are sometimes attacked. The first symptoms of mosaic appear on the plants in autumn, 15–20 days after they show above ground; their growth is retarded, and many of them are stunted and branch intensively. Some acquire a rosette-like appearance and produce no spike-bearing stems, while the yield of the others is reduced by 40–80 per cent. The disease could not be transmitted through the juice or seed of the plants, or the soil, but in tests in 1939 in which insects taken in the field were allowed to feed for 2–5 days on infected wheat plants and were then transferred in batches to healthy seedlings, it was transmitted to the latter by *Laevicephalus* (*Deltocephalus*) *striatus*, L., the incubation period lasting 15–18 days. It is concluded that the disease was due to a virus, and not simply to feeding by the Jassids, since the mosaic appeared on newly forming leaves and not on older ones that were first infested, some of the plants remained healthy in all the tests, though the great number of insects used assured an equal probability of

infection, and in tests in which the Jassids were not given a preliminary infective feed, the proportion of affected plants was extremely low. Similar tests with *Macrosteles* (*Cicadula*) *sexnotata*, Fall., *Delphacodes* (*Delphax*) *striatellus*, Fall., and Aphids gave negative results. The properties of the virus are compared with those of other viruses of wheat.

In the second paper, an account is given of studies in the Province of Voronezh on the disease in spring-sown wheat, oats and barley. The plants are stunted, very few form ears and the seeds are usually small and shrivelled. Most of the affected plants die while forming stalks or setting ears. In contrast to winter wheat, profuse branching was not observed in spring-sown cereals and the upper leaves were more severely affected by mosaic than the lower ones. Experiments on mechanical transmission gave negative results, but the disease was again transmitted by *L. striatus*, with an incubation period of 15–18 days, whether the Jassids were fed on infected plants or taken from the stubble of cereals without an infecting feed.

It is concluded that the same virus causes the disease in autumn-sown wheat and in spring cereals, though the symptoms are different. Its chief host-plant, however, is autumn-sown wheat, without which it would not be able to survive the severe winter. The symptoms it causes in autumn-sown and spring cereals are compared with those of zakuklivanie [*R.A.E.*, A **29** 13].

Citrus Fruit-piercing Moths.—*Gold Coast Fmr* **8** no. 2 p. 29; no. 9 pp. 170–171. Accra, 1939. [Recd. 1940.]

The value of early harvesting and destruction of fallen fruits in reducing loss in grapefruit crops as a result of injury by fruit-piercing moths was investigated during April-June 1938 at experimental stations at Aburi and Asuansi in the Gold Coast Colony. At each station the yellowing fruits were harvested and the fallen fruits destroyed at weekly intervals on one plot of 32 trees and at fortnightly intervals on another. At Asuansi, 14 per cent. of the harvested fruits, 98 per cent. of the fallen fruits, and 82 per cent. of both (the potential crop) were pierced when the work was done weekly, as compared with 11, 98 and 90 per cent., respectively, when it was done fortnightly. The corresponding percentages at Aburi were 13, 96·5 and 65 in the first case and 13, 99 and 78 in the second. Thus there was no reduction in the percentage of harvested fruits injured when the work was done weekly, but the actual number of fruits harvested was considerably greater (about twice as great at Asuansi). Species of *Othreis* were responsible for almost all the injury. The disadvantage of this method is that grapefruits are unsuitable for canning unless they ripen for a considerable time on the tree.

The experiment was repeated at Asuansi during April–June 1939, when the fruits on both the test plots were harvested as soon as they began to turn yellow. The percentages of the potential crop lost owing to the moths were 58 and 55·4 on the plots on which the fallen fruits were destroyed at intervals of 1 and 2 weeks, and 98·2 on a control plot. Again, almost all the damage was due to *Othreis* spp. Fruits picked at first yellowing were unsuitable for canning immediately or after 3 weeks storage; they yielded less juice than tree-ripened fruit, but it was apparently of a quality suitable for the manufacture of fruit-juice products. Other observations showed that grapefruits

on the tree were ripe for eating about 3 weeks after first yellowing but did not become suitable for canning for a further 5 weeks at least; during this period practically all the fruits on protected trees were destroyed by the moths. Fruits picked 2 3 weeks after first yellowing (but not earlier) could be brought to canning condition by storage. Some varieties of sweet orange were ripe for eating 29–33 days after yellowing and navel oranges in half this time. Moreover, navel oranges picked a week before yellowing ripened to marketable condition in storage, so that they could well be protected from moth damage by early harvesting.

It was observed that the punctures made by species of *Othreis* are round, whereas those made by other moths are smaller and somewhat elliptical.

EVANS (I. B. Pole). **Solving the Union's Pasture, Crop and Insect Problems. Annual Report of the Division of Plant Industry.**—*Fmg in S. Afr.* 1939 repr. no. 117, 22 pp., 16 figs. Pretoria, 1939. [Recd. 1940.]

A section of this report (pp. 15–22) deals with beneficial and injurious insects and with diseases of plants observed during 1938–39 in various parts of the Union of South Africa.

The initial large-scale collapse of prickly-pear (*Opuntia*) as a result of attack by *Cactoblastis* [*cactorum*, Berg] has taken longer in South Africa than it did in Australia, but the spread of the Pyralid is in general very good, and fruiting of *Opuntia* has ceased in heavily attacked areas. During 1938–39, 172 million eggs were obtained, of which about half were produced in cages and half collected from the veldt; the number of colonies liberated since 1933 now totals 1,214 [*cf. R.A.E.*, A **28** 190]. Some colonies were again damaged by monkeys and baboons, while *Technomyrmex detorquens*, Wlk. (*albipes*, F. Sm.) and *Anoplolepis custodiens*, F. Sm., destroy the eggs and larvae, respectively. Night temperatures of 60°F. or above give 23–66 per cent. increase in egg production over those ranging from 40 to 50°F., and summer moths deposit five times as many eggs as spring individuals, of which 45 per cent. died in cages without ovipositing. Tests in which wax paper capsules were used for distributing eggs collected in the veldt gave favourable results, 75–95 per cent. of the resulting larvae becoming established. Only 50–80 per cent. did so when the eggs were fixed to the plants by means of adhesives. Infestation of *C. cactorum* in cages by *Nosema* [*cactoblastis* (*cf.* **27** 459)] was high in cages and varied from 5 to 55 per cent. in the veldt, being most severe in overcrowded areas where the food (mainly prickly-pear stumps) was unsuitable. Parasitism by insects was negligible; *Microbracon brevicornis*, Wesm., was not numerous, and in one area this was attributed to the general absence of *Colias electo*, L., which is an alternative host of the Braconid.

Of the introduced species of *Dactylopius* [*cf.* **28** 191], *D. opuntiae*, Ckll., promises to give more effective control of *Opuntia* than *D. coccus*, Costa. With the advent of large populations of the Coccids, *Cryptolaemus montrouzieri*, Muls., is becoming widespread and abundant; this Coccinellid is predacious on *D. coccus* and also on *D. ceylonicus*, Green, and *D. greeni*, Ckll., both of which occur on *O. monacantha*. *D. opuntiae* was also attacked in one area. *D. confusus*, Ckll., continued to give satisfactory results on *O. aurantiaca* [*cf.* **28** 375], and was

observed on the leaf-pads of *O. tardiospina* in an area in the western Transvaal. The Lamiids, *Lagochirus funestus*, Thoms., and *Moneilema ulkei*, Horn, were introduced from Australia to supplement *Cactoblastis* on the tree type of pear. The former showed great promise in the destruction of prickly-pear stems, but has not so far been liberated in the field on account of the probable injury that it would cause to spineless cactus. *M. ulkei* breeds very slowly, and is still under observation in the laboratory.

Work on *Scirtothrips aurantii*, Fauré, on *Citrus* showed that the control given by two double applications of sulphur dust, when 75 per cent. of the petals had fallen and again after 10 days [*cf.* **22** 80], was not improved by a third application 21 or 152 days later. The omission of the first application rendered control unsatisfactory. Orchard sanitation was shown in 1937–38 to be of benefit in reducing infestation of oranges by *Argyroploce leucotreta*, Meyr.; a list of its wild and cultivated food-plants is given. Numerous adults of *Ceratitis capitata*, Wied., were again observed sheltering in deciduous fruit trees long after the crop was harvested [*cf.* **28** 191], and very large populations were also found in such trees as japonica [*Lagerstroemia*], which bears no fruit, and especially in three varieties of *Citrus*. Methyl bromide gave promising results in small-scale tests against *C. capitata* in harvested fruit (apples, pears, guavas and figs) and *Ephestia elutella*, Hb.

Control of *Gonipterus scutellatus*, Gylh., on *Eucalyptus* by *Anaphoidea nitens*, Gir. [*cf.* **23** 508] is improving in all areas, though somewhat masked by drought conditions, and was conspicuous in large areas of the Transvaal highveldt. *Euproctis terminalis*, Wlk., has been brought well under control on pines in the Jessievale district of the Transvaal following dusting operations [*cf.* **28** 405] over 3 years in various parts of the plantations. Infestation of *Pinus leiophylla* is still more or less constant and that of *P. patula* variable, but neither is epidemic. At Belfast, also in the Transvaal, complete control was given by an unidentified fungous disease. Ecological studies of the two strains of the moth that occur at Jessievale and Belfast, respectively, showed that the pupae of both require high humidity, but that the conditions required for oviposition and hatching vary. In the laboratory, the Belfast strain was reared on the leaves of pin oak [*Quercus palustris*] [*cf.* **28** 404], but black wattle (*Acacia mollissima*) was the only successful laboratory food for the Jessievale strain. It is now accepted that two subspecies of the Saturniid, *Nudaurelia cytherea*, Cram. [*cf.* **24** 335; **28** 191], are present in forests in South Africa, the typical one and *N. c. capensis*, Stoll. There are two strains of the latter, one in the Cape Peninsula and the other in Weza, Natal, of which the adults emerge in April-May and January–March, respectively. Infestation of deciduous trees by *Teragra guttifera*, Hmps., was unchanged in the Langkloof area, where it is restricted to those on poor soil, but this Metarbelid also attacked trees in Natal on better sites. As infestation was low, however, it was effectively controlled by applying Stockholm tar to the openings of the burrows. Trees liable to attack are *Salix babylonica*, *S. capensis*, *Populus deltoides* and *Platanus accrifolia*. The partial failure of a dust of natural cryolite applied from the air for the control of *Acanthopsyche junodi*, Heyl., on wattle (*Acacia*) was found to be due to excessive grinding of the insecticide, which favoured the formation of very small lumps. A pyrethrum dust (Dry Pyrocide [*cf.* **26** 725]) was promising in

laboratory experiments. Wattle was seriously damaged in three areas by *Polychrosis incultana*, Wlk. [*cf.* **28** 405]. Laboratory experiments on the control of the Jassid, *Bythoscopus cedaranus*, Naudé, and the Capsid, *Lygidolon laevigatum*, Reut., which also attack wattle, showed that pyrethrum dust was superior to derris, thiocyanates or dinitro-ortho-cresol and promises to be effective against the nymphs at dilutions of 1 : 15 or 1 : 20.

As it was shown in the laboratory that the survival of *Busseola fusca*, Fuller, on maize would be favoured by winter and spring rains, which hasten pupation of the overwintering larvae, planting of the crop in wet seasons should be delayed; females began to oviposit 24–36 hours after emergence and continued for up to a fortnight, which represents their maximum longevity in captivity. *Bruchus* (*Callosobruchus*) *chinensis*, L., caused serious damage to stored cowpeas, but fumigation with Cyanogas calcium cyanide gave satisfactory control under winter conditions. Fumigation experiments against *B. chinensis* and *Calandra* (*Sitophilus*) *oryzae*, L., in bagged grain showed that exposure for as long as 2½ hours to hydrocyanic acid gas under reduced pressure gave a small immediate kill, but that a high mortality resulted if the grain was left undisturbed for 48–72 hours; methyl bromide was quicker in action than HCN. Spraying tobacco warehouses with a pyrethrum extract in white oil under pressure gave good control of *Ephestia cautella*, Wlk.

Allodontermes schultzei, Silv., and certain species of *Microtermes* continued to cause trouble to floriculturists, and have recently begun to destroy young grape vines in one area. In further work on the control of harvester termites (*Hodotermes* spp.), excellent results were given by a bait of sweetened sodium arsenite in finely cut grass broadcast when the termites were reasonably active, but sodium fluoride and sodium chloracetate did not prove satisfactory for use in such baits [*cf.* **23** 676]. Copper sulphate finely powdered and applied to young newly planted fruit trees at the rate of 4 oz. per tree effectively protected them for 9 months from attacks by fungus-growing species. Termites of this group are causing increasingly serious injury to timber in buildings, particularly on the Reef and in Pretoria.

Observations on the parasites of the cabbage moth, *Plutella maculipennis*, Curt., showed that the percentage parasitism by the introduced Ichneumonid, *Angitia cerophaga*, Grav., amounted in one instance to 50; 18 indigenous parasites of this moth have now been recorded. During the summer its numbers were greatly reduced by the fungus, *Entomophthora sphaerosperma*, but they have now reached a higher level than before. Other pests recorded during the year included *Myzus* (*Aphis*) *persicae*, Sulz., which caused considerable damage to thin-leaved types of tobacco; *Loxostege frustralis*, Zell., which seriously injured fodder bushes on the Karroo; *Nodaria extinctalis*, Zell., on baled lucerne; *Achaea lienardi*, Boisd., which defoliated indigenous trees of the genera *Ptaeroxylon*, *Sideroxylon*, *Pappea*, *Rhus*, *Maerua* and *Schotia* near Bathurst; the Trypetid, *Zacerata asparagi*, Coq., on cultivated asparagus; *Lagria villosa*, F., on strawberry; and *Parasa johannes*, Dist., which defoliated *Quercus robur* (*pedunculata*). Larvae of *Vanessa cardui*, L., were reported in large numbers on burrweed (*Xanthium spinosum*) in a district in Natal.

Field observations on *Locustana pardalina*, Wlk. [*cf.* **28** 331] were continued in the Middleburg and De Aar districts. Two generations of ph. *gregaria* and three of ph. *solitaria* were completed during the

season. It was found that overstocking favours an increase in the locust population by extending suitable habitats. Experiments on bait carriers showed that although mixtures of sawdust and maize bran or maize meal gave good results, the employment of such mixtures could not be recommended, as the sawdust obtainable is usually moist and its drying presents practical difficulties, while the mixture of moist sawdust with bran or meal leads to the fermentation of the bait. Tests carried out with two brands of dinithro-ortho-cresol dusts containing about 10–12 per cent. of active ingredient and 88–90 per cent. of carrier produced good results against hoppers and adults of *L. pardalina* and *Nomadacris septemfasciata*, Serv. They acted as contact dusts and killed within two hours. These dusts are less toxic to mammals than arsenicals and have the further advantage of losing their toxicity some time after being broadcast. In attempts to find suitable substitutes for sodium arsenite, good results against *Nomadacris* hoppers were obtained with baits made with sodium fluosilicate and sodium fluoride, which however have to be used at the strength of 5 per cent. to give mortalities as high as those obtained with 3 per cent. sodium arsenite. The spraying of caged locusts with a spore suspension of the green fungus resulted in a mortality of 90 per cent.

CHERIAN (M. C.) & KYLASAM (M. S.). **Further Studies on the Control of *Laphygma exigua* a Pest of Tobacco Nurseries.**—*Proc. Ass. econ. Biol.* [*India*] *1938* repr. 5 pp., 1 ref. Coimbatore, 1938. [Recd. 1940.]

An account is given of experiments on the control of *Laphygma exigua*, Hb., on tobacco in nurseries at Chirala [*cf. R.A.E.*, A **28** 439] carried out in 1937–38. It is known that the larvae are not controlled by 4–5 applications of lead arsenate (½ oz. per gal.) over about a month, and it was shown that this is due to the repeated overhead irrigation of the beds during the day, which washes the poison off the leaves ; the large acreage to be covered makes spraying in the evening after irrigation impracticable. The prevailing strong winds made it impossible to cover the lower surfaces of the young leaves with a dust of calcium arsenate and lime, and the dust, like the spray, was washed off by irrigation.

Seedlings of ragi (*Eleusine coracana*), planted in strips on the edges of tobacco beds for erosion control, were observed to be heavily infested by larvae of *Laphygma*, and comparison of populations showed that tobacco beds surrounded by ragi tended to contain more larvae than those without it, owing to migration from the borders, while the strips of ragi sometimes contained 8–15 times as many larvae as the tobacco beds. Attempts were made to reduce the population on tobacco seedlings by planting ragi at the time of maximum emergence of the moths (about the last week in August) to attract the ovipositing females. The seedlings were very attractive to the moths for 4 or 5 days after germination, but oviposition was not heavy after the first 4 days ; 14 days after germination the plants became coarse and unpalatable to the larvae, which then tended to migrate to the tobacco beds. The seedlings should, therefore, not be left in the ground for more than a fortnight. Daily hand-picking of egg-masses and larvae from ragi during the 15 days of maximum infestation was unsuccessful, as some egg-masses were overlooked and many larvae were dislodged and moved to the tobacco beds, considerably increasing the infestation

of the latter. A spray of lead arsenate and soap applied to the strips of ragi appeared to give good control in preliminary tests, and this treatment may supplant hand-picking. Removing the ragi seedlings with the egg-masses on them and resowing the strip every 6 days caused a considerable diminution in the numbers of larvae and made spraying unnecessary.

List (G. M.). **The Potato and Tomato Psyllid and its Control on Tomatoes.**—*Bull. Colorado Exp. Sta.* no. 454, 33 pp., 6 figs., 12 refs. Fort Collins, Col., 1939. [Recd. 1940.]

In this bulletin are summarised the results of work in Colorado on the bionomics and control of *Paratrioza cockerelli*, Šulc, on tomatos. Secretions injected by the nymphs in feeding give rise to the condition known as psyllid yellows, the symptoms of which are described. The number that will cause noticeable injury varies with the size, stage of maturity and variety of the plant. An early attack may so stunt the plants that they will fail to bear fruit, whereas an attack late in the season, after the plants have become well-developed vegetatively, may stimulate blooming and fruit-setting. The effect on the size and quality of the fruit varies with the degree of infestation.

All stages of the Psyllid are briefly described. It overwinters in the adult stage and appears on its spring food-plants in tomato-growing areas about the middle of May. There are about 5 overlapping generations in the field during the season; 300–400 eggs are laid by each female over a period of 2–3 weeks. At winter greenhouse temperature, the time from emergence of adults to sexual maturity was 3 6 days, while the egg and nymphal stages and the complete life-cycle lasted 5–8, 13–24 and an average of about 27·5 days, respectively.

The reaction of the Psyllid to temperature [*cf. R.A.E.*, A **27** 408] and control measures tested in the field in 1934–36 [*cf.* **27** 72, etc.] are discussed. A derris dust containing 0·5 per cent. rotenone and pyrethrum powder containing 0·17 per cent. pyrethrins were ineffective against the nymphs, but a mixture of 1 part Dry Pyrocide (containing 2 per cent. stabilised pyrethrins) and 9 parts gypsum showed definite effectiveness. Dusts and sprays that leave a deposit of sulphur killed the nymphs [*cf.* **27** 72] and repelled the adults for as long as the sulphur remained on the plants. Nymphs transferred to leaves as much as 16 days after they had been treated were almost all killed, and though eggs hatched freely on a treated surface, few of the nymphs survived. The injury caused to tomatos by lime-sulphur [*cf.* **27** 72] is more severe when the temperature is high and on rapidly growing plants. A mist spray that is discontinued before the dripping point is reached causes less injury than a coarse driving spray or a drenching spray. In preliminary tests, a spray of 1 U.S. gal. liquid lime-sulphur (33°Bé) and 4 lb. 300-mesh wettable sulphur in 80 U.S. gals. water caused a high mortality of the nymphs without noticeable scorching or retardation of plant growth. It is possible that the larger particles of wettable sulphur may give a residual effect of longer duration than the extremely small colloidal particles of sulphur formed in the decomposition of lime-sulphur.

Recommended control measures against *P. cockerelli* on tomato include treating the plants thoroughly with 300-mesh dusting sulphur, a spray of 1 lb. 300-mesh wettable sulphur per 10 U.S. gals. water or the spray of lime-sulphur and wettable sulphur, 10 days before the plants

are taken from the greenhouse or cold frame, 10 days after they have been planted in the field, again when they are branching freely and beginning to blossom, and finally just before they begin to spread. In regions where conditions are favourable to the Psyllid, the plants should be treated again during mid-season and late summer if many nymphs are present. Fruit that has been treated with sulphur shortly before harvest should be washed and peeled before being canned [but *cf.* **28** 489]. Preliminary tests indicate that reasonably effective control can be secured and excessive amounts of sulphur on the fruit avoided by using Dry Pyrocide with talc, colloidal clay or other suitable dusting material when treatment during the harvest season becomes advisable. The doors and ventilators of greenhouses used for growing tomatos should be screened with netting of 14 meshes per inch.

Thirty-third Annual Report of the Department of Agriculture (British Columbia) for the Year 1938.—114 pp., 3 pls. (1 col.). Victoria, B.C., 1939. [Recd. 1940.]

The Report of the Horticultural Branch (pp. L27–L42) by W. H. Robertson includes notes on the incidence of several insect pests. No new outbreaks of the potato beetle [*Leptinotarsa decemlineata*, Say] were reported during the year [*cf. R.A.E.*, A **27** 67], and infestation was reduced where control measures were carried out. The pea moth [*Cydia nigricana*, Steph.] occurs in many parts of the Frazer Valley, where peas for canning are extensively grown. Since it materially affects the production of canning peas, a control area was set up in a district where it was scarce, in which the cultivation of peas for purposes other than canning was prohibited, with satisfactory results.

The weather during the summer was favourable to the development of the codling moth [*Cydia pomonella*, L.] on apple. The numbers of adults caught in 12 traps daily throughout July in 1934–38 are given in an appendix (p. L108); more were caught in 1938 than in any of the four previous years. Good control was given in spraying trials by a fixed nicotine (Black Leaf 155), thiodiphenylamine (phenothiazine) and cryolite. The first two were at least as effective as lead arsenate, although more costly, and the residues are considered to be harmless. The value of heating packing houses that contain empty boxes early in the season to hasten and complete the emergence of adults before the boxes are needed in the orchard was investigated. Burlap bands taken from the trees on 8th December were placed in boxes covered with butter muslin in various parts of a room containing approximately 60,000 boxes. Heating equipment was situated in one corner of the room and an overhead circulating fan was suspended from the ceiling a short distance away. Heating was begun on 17th May; the temperature became constant throughout the room 3 days later, and was maintained until 7th June, when heating was discontinued. Emergence began after a fortnight and increased rapidly for a time, declining towards the end of the period. A few adults were caught shortly before the boxes were required on 30th June, but it is thought that the boxes would have been completely cleared if heating had been started 10 days earlier. The cost of the treatment was low.

The European red mite [*Paratetranychus pilosus*, C. & F.] is prevalent in the south and was most injurious on pears, prunes and two varieties of apple during 1938. A single application of lime-sulphur (1 : 40) on prunes shortly before the flowers opened gave almost complete

control, whereas one made a few days earlier on pears in a neighbouring orchard was ineffective; in view of this variability, trials were made with a number of other sprays. Fairly good control was given on apple by a single application of a spray containing 10 lb. soluble sulphur in 50 gals. water made when the tips of the buds were showing green. Later in the season two applications, separated by an interval of 5–6 days, of 1 per cent. summer oil gave almost complete control. Cosmic sulphur (1 : 200) was equally effective and caused no injury to fruit or foliage, although temperatures of about 90°F. prevailed for several days before and after spraying, and the spray was applied to trees carrying a fairly heavy deposit of lead arsenate. The best control of all, however, was obtained on trees sprayed with water only.

The mealybug [*Pseudococcus* sp.] that attacks fruit trees in the Kootenays [**27** 66, etc.] was less injurious on apple during 1938, partly as a result of improved spraying and partly owing to very warm, dry weather in September and part of October, which hindered the development of sooty fungus on the fruit. In trials with dormant sprays, a proprietary oil containing 4 per cent. actual oil mixed with lime-sulphur (1 : 15) gave better results than two others or than the same oil containing 6 per cent. actual oil without lime-sulphur.

The report of the Provincial Entomologist (p. L49), by M. H. Ruhmann, comprises very brief notes on the incidence of a number of insect pests. There was a slight increase in the number of orchards infested by *Aspidiotus perniciosus*, Comst., and it was observed in two new places.

Poisson (R.). **Sur la réproduction agame de** *Myzus persicae* **(Sulz.) (Hémiptère Phytophthire Aphididae) en Bretagne.**—*C. R. Soc. Biol.* **133** no. 4 pp. 634–636. Paris, 1940.

Observations by the author have shown that on some parts of the coast of Brittany, particularly in the region of St. Malo, where early vegetables are produced, *Myzus persicae*, Sulz., which is an important vector of potato virus diseases, can reproduce parthenogenetically throughout the winter on the eyes of seed potatoes stored in barns and attics. In those that are above or beside animal quarters, the temperature rarely falls below 4–5°C. [39·2–41°F.], which is above the minimum that this Aphid can survive. The earliest potatoes are planted about mid-March, when its secondary food-plants are rare, peach (the primary food-plant) is still leafless, and night-temperatures at ground level often fall to about freezing point. Winged females would be able to migrate at planting time, but those that do not enter rooms where potatoes are stored for later planting presumably die without reproducing. There is, however, a possibility that wingless Aphids on the eyes and under the shoot scales may survive on the tubers in the soil.

In observations near St. Malo at the beginning of April 1940, when early potatoes planted about 3 weeks before had suffered from late frosts, the author found no Aphids on their leaves or on the shoots and young leaves of peach trees in full bloom. He observed young Aphids, however, on the underground stems of some of the potatoes, forming small colonies near the surface of the soil. The occurrence of milder nights would almost certainly induce reproduction and infestation of the stems above ground. Additional infestation would subsequently result from migrants from peach, but this would usually affect only late potatoes in June and July.

Besides the risk of virus transmission through infestation of seed potatoes, the eyes are weakened by the loss of sap, and the resulting plants show reduced resistance to late frosts and attack by *Leptinotarsa decemlineata*, Say.

REGNIER (R.). **Contribution à l'étude des hannetons. Un grand ennemi des gazons** : *Amphimallon majalis* **Razoumowsky.**—*Ann. Epiphyt.* (N.S.) **5** fasc. 3 pp. 257–265, 5 figs., 11 refs. Paris, 1939. [Recd. 1940.]

In Normandy, the three most important Melolonthids are *Rhizotrogus aestivus*, Ol., *Amphimallus solstitialis*, L., and *A. majalis*, Raz. [*cf. R.A.E.*, A **26** 229]. The larva and pupa of *A. majalis* are briefly described, and characters are given distinguishing the adults from those of other Melolonthids. The larvae prefer to feed on grass roots, and are most harmful in light, especially sandy, soil. They cause considerable injury to turf, the damage being similar to that by *A. solstitialis*, with which it has probably been confused in the past, since the larvae and life-cycles of the two species are similar. From turf the larvae pass to other plants, particularly graminaceous ones and those having abundant root-hairs, including strawberry, leguminous plants and such bushes as privet. The adults are present in north-western France from the end of June to mid-July. They fly at nightfall, usually about 10 minutes later than those of *A. solstitialis*, and are numerous near poplars, though experimentally poplar leaves did not appear to be suitable food for them. The eggs, which are laid singly in cavities in the soil, hatch in August. Females laid up to 18 eggs in the laboratory, but this number is probably exceeded in nature. The larvae are not really harmful until the summer after they hatch, when they become very active and remain so until the advent of severe cold weather causes them to descend deep into the soil. Even if the winter is mild, they feed little from October to March. Pupation occurs, generally in the following June, at a depth of 4–8 inches, and the pupal period lasts 15–21 days.

Many of the larvae are destroyed by birds, and some were found infected with a bacterial disease. It is considered that the record of young rooks feeding on the adults in spring [**19** 659] should probably refer to some species of *Rhizotrogus*, since those of *A. majalis* are not normally present at this time. There is no effective and cheap means for controlling infestation. Carbon bisulphide was the best of three soil fumigants tested, but a high rate of application (at least 2 oz. per sq. yard) was necessary. The incorporation of clay in sandy soil near poplars renders it unattractive to ovipositing females. Infested ground in gardens and parks should be dug in September and the larvae collected. Poultry and other birds will destroy many of the larvae thus exposed.

BONNEMAISON (L.). **La maladie bronzée de la tomate.**—*Ann. Epiphyt.* (N.S.) **5** fasc. 3 pp. 267–308, 22 figs., 4 pp. refs. Paris, 1939. [Recd. 1940.]

In this paper the author records observations made in south-western France in 1936-37 and near Lyons in 1938 on spotted wilt of tomato, of which the vector in France is *Thrips tabaci*, Lind. The history of work on the association of insects, particularly thrips, with virus

diseases of plants is summarised, the characters of the virus of spotted wilt are reviewed, largely from the literature, all stages of *T. tabaci* are described, with special reference to the mouth parts of the larva and the adult female, a list is given of the plants (23 Solanaceae and 27 in 16 other families) from which the virus has been recorded, the behaviour of the virus in the thrips is reviewed from the literature, and an account is given of the symptoms observed by the author in naturally infected tomato, tobacco, *Dahlia*, *Zinnia* and China aster (*Callistephus chinensis*) and also in some artificially infected plants. The symptoms of the disease in France differ slightly from those observed in other countries, and are not the same in the Gironde as in the region of the Rhône, where yellowing of the leaves of tomato occurred later in vegetational development; these variations are attributed to diversity in environment. In experiments, the virus was transmitted from infected to healthy tomato by *T. tabaci*, and to six other plants by mechanical means.

In central and southern France, *T. tabaci* is apparently able to hibernate in any stage, but large numbers of the thrips are destroyed by heavy winter rains. In greenhouses, development is accelerated, and at the end of spring the adults migrate from greenhouses to the fields and spread the virus. In the Gironde, the thrips is common on onion until about 10th July, when heavy rains usually reduced its numbers, so that it is very rare in August. The first individuals on tomato in this region were observed on 3rd June in 1937, but they were not numerous then or in July, though rains were infrequent; *Frankliniella intonsa*, Tryb., was, however, plentiful [*cf. R.A.E.*, A **25** 649]. Observations near Lyons in 1938 showed that *T. tabaci* was rare on onion; it occurred chiefly on potato, tomato and nasturtium (*Tropaeolum*). A sudden decrease in its numbers on potato from 13th July onwards was due to the plants withering. The first adults appeared towards the end of May and the thrips occurred in the open up to the end of November. Five or six generations are possible in a year. In breeding experiments, the egg stage, the two larval instars and the prepupal and pupal stages averaged 7, 3·5, 4·2, 1·9 and 4·8 days at 21°C. [69·8°F.], but at 27°C. [80·6°F.] development lasted only 17 days. Adults survived for 12–17 days. Reproduction is principally parthenogenetic, and no males were taken by the author.

Direct control of the thrips is difficult, but good results were given by 3 applications at intervals of 10 days of a spray containing 2 pints 50 per cent. nicotine, 0·3 lb. sodium carbonate, 10 lb. Castille soap and 100 gals. water. Dusting with pyrethrum, or with a mixture of 1 part pyrethrum and 9 parts flowers of sulphur, gave variable results. Fumigation with naphthalene is usually effective in greenhouses. The virus is preserved during the winter in tubers and roots as well as in greenhouse plants. The chief source of infection is the spring planting of infected tubers, such as dahlias. In spring, all plants showing symptoms of disease should therefore be eliminated, but this will not give complete control as some host plants show no symptoms.

Suire (J.). **Contribution à l'étude de quelques coléophores, parasites des arbres fruitiers.**—*Ann. Epiphyt.* (N.S.) **5** fasc. 3 pp. 309–338, 24 figs., 3 pp. refs. Paris, 1939. [Recd. 1940.]

Keys are given to the larvae, based on the characters of their cases, of 13 species of *Coleophora* that feed on the foliage of fruit trees in the

palaearctic region, and to the adults, based on the genitalia, of 12 of them, together with information on their classification, distribution, morphology, biology and food-plants and the injury that they cause. Those that are said to be of some economic importance in France in addition to *C. hemerobiella*, Scop. [*cf. R.A.E.*, A **25** 2] are *C. nigricella*, Steph., *C. anatipennella*, Hb., *C. fuscedinella*, Zell., *C. badiipennella*, Dup., and *C. currucipennella*, Zell. All of them are polyphagous.

C. nigricella and *C. anatipennella* are characteristic species and are therefore dealt with in detail. *C. nigricella* oviposits from the end of May onwards and the larvae hatch in 10–15 days. They hibernate from October to March, are not much affected by cold and have been found feeding in spite of early frosts. In spring they attack the leaf-buds. Pupation occurs in May and the pupal stage lasts 15–20 days. Adult longevity did not exceed 23 days. The adults of *C. anatipennella* generally emerge early in June, but emergence has been observed to occur at the end of April. Oviposition begins 2 days later. Females laid an average of about 100 eggs over a maximum period of 3 weeks. The egg stage averaged 12 days. The larvae entered hibernation at the end of October and fed on the leaf-buds in spring. Pupation begins about mid-April, and the adults emerge after 15–20 days. Control measures are briefly reviewed from the literature.

CHABOUSSOU (F.). **Contribution à l'étude biologique de *Lebia grandis* Hentz, prédateur américain du doryphore.**—*Ann. Epiphyt.* (N.S.) **5** fasc. 3 pp. 387 433, 39 figs. Paris, 1939. [Recd. 1940.]

A briefer account of these laboratory observations in France on *Lebia grandis*, Hentz, which was introduced from the United States for the control of *Leptinotarsa decemlineata*, Say, on potato, has already been noticed [*R.A.E.*, A **28** 445]. The morphology of the larvae and adults of this Carabid is discussed at some length, and information is given enabling the various stages in its larval development to be recognised. The author concludes that it is a most efficient and specific enemy of *Leptinotarsa*; the larvae are ectoparasitic on the full-fed larvae and pupae of the latter in the soil, while the adults are predacious on the eggs and larvae. As, however, high temperatures are necessary for oviposition and humidity in the soil for the development of the egg and larva, these conditions, which obtain in the eastern United States in the summer, would restrict the possibility of its acclimatisation in Europe to eastern Germany and Poland.

WATSON (M. A.) & ROBERTS (F. M.). **Evidence against the Hypothesis that certain Plant Viruses are transmitted mechanically by Aphides.** —*Ann. appl. Biol.* **27** no. 2 pp. 227–233, 9 refs. London, 1940.

Plant viruses transmitted by sucking insects appear to fall into two categories, comprising a persistent type, the vectors of which remain infective for an indefinite and often long time and which frequently require an incubation period in this insect, and a non-persistent type, the vectors of which remain infective for a short but comparatively constant period but are able to transmit infection immediately after

acquiring it. It is generally accepted that a non-persistent virus is transmitted mechanically and that loss of infectivity results from the cleansing of the stylets while the vectors are feeding [*R.A.E.*, A **17** 281] or to normal deterioration of the virus while they are fasting. In a paper already noticed [**28** 301], the authors pointed out that the retention of infectivity by Aphid vectors, either fasting or feeding, of non-persistent viruses is considerably less than the inactivation rates of the viruses *in vitro*, and suggested that the methods of transmission of the two types are fundamentally similar, but that the vectors, while feeding, produce an inactivating substance to which the persistent viruses are resistant.

Evidence in support of this theory was provided by experiments, which are described, on the transmission by *Myzus persicae*, Sulz., of three non-persistent viruses, *Hyoscyamus* virus 3, potato virus Y and the severe etch virus of tobacco. Single Aphids that had previously fasted for an adequate period and were subsequently allowed to feed for 2 minutes on infected plants successfully transmitted each virus to a number of healthy plants in succession within the time for which they would normally retain their infectivity if prevented from feeding, provided that they were allowed to feed on each plant for only 2 minutes. It is concluded that the viruses are inactivated by some substance produced by the Aphids when feeding for more than 2 minutes.

Thomas (I.) & Jacob (F. H.). **The Strawberry Aphis—***Pentatrichopus* (*Capitophorus*) *fragariae* **Theob., with Notes on** *P. potentillae* **Walk. and** *P. tetrarhodus* **Walk.**—*Ann. appl. Biol.* **27** no. 2 pp. 234–247, 5 figs., 9 refs. London, 1940.

Although strawberries in the eastern part of North Wales have suffered severely from degeneration, those in some districts of the western part appear to flourish. Investigations were therefore carried out in 1937–39 on the bionomics of *Capitophorus* (*Pentatrichopus*) *fragariae*, Theo., which transmits the virus disease or diseases [*cf.* *R.A.E.*, A **26** 104] responsible for this condition, with a view to the discovery of areas, especially in the west, where strawberry runners are likely to remain free from infestation. In a brief discussion of synonymy, the authors point out that Ris Lambers stated that *C. fragariae* and *C. fragaefolii*, Ckll., were both synonyms of *C.* (*P.*) *potentillae*, Wlk. [**21** 534] ; all three are referable to *Pentatrichopus* if, as in the authors' view, this is generically distinct from *Capitophorus*. Ris Lambers now, however, regards *fragaefolii* as distinct from *potentillae* ; and the authors consider that though *fragariae* may be a synonym of *fragaefolii*, sufficient evidence to decide this point is not available [*cf.* also **26** 103]. Specimens received from the United States and Canada and taken on species of *Potentilla* and *Rosa* appear to differ from all three species and may have been mistaken for, or described as, *C. fragaefolii* or *C. potentillae*. Keys are given to the apterous and alate viviparous females of *C. fragariae*, *C. potentillae* and *C.* (*P.*) *tetrarhodus*, Wlk., a British species that normally occurs on roses, together with brief notes on differentiating characters.

The bionomics of *C. fragariae* in North Wales resemble those in England [*cf.* **26** 104, 613]. Though the Aphid overwinters on

strawberries in the apterous viviparous stage, viviparous alatae and nymphs with wing buds have been found in late autumn and winter ; only one oviparous female was observed out of doors, but more are produced under greenhouse conditions. Details are given of the results of population counts made during 1938 and 1939 in fields in the eastern strawberry-growing area, where crops have deteriorated since 1911, and in a more westerly district, where degeneration has set in very recently. In 1938, the population in the former area reached a peak on 26th May, when there were as many as 9,748 Aphids per 100 leaves in one field, whereas in the west the peak occurred on 22nd June, when there were 3,808. Populations were very low in 1939, and alatae were not observed in that year though they were numerous in May and June 1938. An experimental plot was planted in the autumn of 1937 with strawberries of several varieties ; most of the plants were severely infested, and half of them were treated with warm water before planting ; by the following spring, all the plants had become infested as a result of the movement of the apterae. Evidence was obtained that these can move over bare soil for a distance of at least a yard. Alatae migrate over at least a mile. Small experimental plots isolated in districts where strawberries are not grown on a large scale remained free from infestation in 1938, when alatae were numerous, and in 1939, but an increase in the size of the plots would result in increased risk of infestation, and further observations on larger plots are needed before recommendations can be made.

When transferred to them, *C. fragariae* lived readily on *Potentilla anserina* and *Fragaria vesca*, both of which are very common weeds in North Wales, and on *P. sterilis* and *F. moschata*, but did not survive on *P. reptans* or *Rosa rugosa* ; in the field it was observed only once on *P. anserina*, when it was associated with *C. potentillae* on plants growing near infested strawberries. In 1940, however, the alatae colonised *R. rugosa* under glasshouse conditions. *C. potentillae* survived on *P. anserina*, but not on any of the other five plants or on cultivated strawberry. *C. tetrarhodus* lived readily on strawberry and *F. vesca*, and less readily on *P. sterilis*, *P. anserina* and *P. reptans*, but as it is not abundant and was found only on species of *Rosa* in the field, it is considered unlikely to become of economic importance.

Other Aphids that occurred on strawberry were *Macrosiphum solanifolii*, Ashm., which was the most abundant, more than 200 individuals being found on 100 leaves in 1938, and which was present from early February until mid-July ; a few alates and nymphs of *M. rubiellum*, Theo. ; *M.* (*Aulacorthum*) *solani*, Kalt. (*Myzus pseudosolani*, Theo.), which bred freely on strawberry plants growing near potatoes ; small numbers of alatae and apterae of *Myzus ornatus*, Laing ; and *Anuraphis padi*, L. (*Brachycaudus helichrysi*, Kalt.) and *Cavariella aegopodii*, Scop., which occurred as accidental migrants. *Macrosiphum solanifolii* and *M. rubiellum* overwintered in the egg stage on strawberry in 1939-40. A table shows the numbers of Aphids other than *C. fragariae* per 100 leaves on various dates between 11th February 1938 and 9th September 1939. The only other strawberry pests observed were *Tarsonemus pallidus*, Banks, which was prevalent in some districts and has caused severe damage ; *Tetranychus telarius*, L., which was observed in most districts, but caused damage in only two fields, both in the same area ; the Tortricid, *Peronea* (*Acalla*) *comariana*, Zell., which was found on a single farm ; and *Lygus pratensis*, L., which was not sufficiently numerous to be injurious.

TATTERSFIELD (F.) & POTTER (C.). **The Insecticidal Properties of Certain Species of *Annona* and of an Indian Strain of *Mundulea sericea* (" Supli ").**—*Ann. appl. Biol.* **27** no. 2 pp. 262–273, 1 fig., 24 refs. London, 1940.

The following is almost entirely the authors' summary : Laboratory insecticidal trials, made with several species of *Annona*, *A. muricata*, *A. palustris*, *A. reticulata*, *A. squamosa*, show that plants of this genus possess contact insecticidal properties to Aphids. *A. reticulata* was the most potent of those tested. Seed, root, leaf and to a less extent the stem of this species possessed contact insecticidal properties. The seed of *A. muricata* and the leaves of *A. squamosa* and *palustris* also showed contact toxicity, but were not so potent as *A. reticulata*. The seed of *A. squamosa* was not available for testing purposes. None of the above are superior to the leaf, root and bark of *Mundulea sericea* of the variety known in India as " Supli," and all are much less toxic than the richer specimens of *Derris elliptica* root, such as Changi no. 3. The toxic action of the species of *Annona* appears to be rather specific. Aphids are susceptible but adults of *Oryzaephilus surinamensis*, L., which are susceptible to the rotenone class of insecticides, are resistant.

Tests with extracts of the " Supli " variety of *Mundulea sericea* from India showed that leaf, bark and root possessed marked insecticidal properties when tested on *Macrosiphum* (*Macrosiphoniella*) *sanborni*, Gill., and *O. surinamensis*. This is in contrast with the African variety, the leaf and root of which are reported as distinctly less potent than the bark [*R.A.E.*, A **26** 34]. The toxicity of none of these parts is of the same order as that of the root of *Derris elliptica*, Changi no. 3.

MARTIN (J. T.). **The Problem of the Evaluation of Rotenone-containing Plants. V. The relative Toxicities of different Species of Derris.**—*Ann. appl. Biol.* **27** no. 2 pp. 274–294, 26 refs. London, 1940.

The following is based largely on the author's summary : The relative toxicities to *Aphis rumicis*, L., of sprays containing extracts of the roots of two varieties of *Derris elliptica* and two of *D. malaccensis* were determined by using an apparatus already described [*R.A.E.*, A **23** 81], and the data obtained were subjected to statistical analysis. One of the varieties of *D. elliptica* was that known as Changi no. 3, which has been developed by selection in Malaya and yields about 12 per cent. rotenone and 25–30 per cent. ether extract. Varieties of *D. malaccensis* are characterised by the presence in their resins of varying quantities of toxicarol and, in general, by a low proportion of rotenone to total ether extractives. *D. elliptica* (Changi no. 3), *D. malaccensis* (Sarawakensis) and *D. elliptica* (Sarawak creeping) were respectively $2\frac{1}{2}$, $1\frac{3}{4}$ and $1\frac{1}{4}$ times as toxic as *D. malaccensis* (Kinta). The relative toxities of the first three were found to be of the same order when they were tested against *Oryzaephilus surinamensis*, L., in a spraying apparatus, of which a description has not yet been published, designed by C. Potter to give a uniform deposit over an area of approximately 70 sq. cm. and suitable for use with quickly moving insects.

Various methods suggested for the chemical evaluation of derris are examined and discussed. Those based upon optical rotation values [**25** 111] are shown to be of no value where the roots and resins

of different species are to be evaluated, and the method of Jones & Smith [B **25** 9], in which a definite toxic value is given to the non-rotenone fraction of the derris extract, is inadequate when applied to the roots under consideration. The determination of the percentage "rotenone equivalent" values of the roots, based upon the alkaline fractionation of the resins and the toxicities of the deguelin and toxicarol fractions relative to that of rotenone, has given a reasonably close estimate of the derris roots examined. The application of the method to the assessment of the toxic value of derris resins is described.

Hosny (M.). **On Coccids found on Roots of Plants in Egypt.**—*Bull. Minist. Agric. Egypt* no. 237 [4] 21 pp., 3 col. pls., 15 refs. Cairo, 1939. [Recd. 1940.]

Owing to the fact that Coccids have caused severe damage to the roots of plants in many localities in Egypt since 1932, when *Pseudococcus brevipes*, Ckll., was found attacking the roots of *Phoenix* in pots [*R.A.E.*, A **23** 676], a thorough search was made for all Coccids living on the roots of cultivated plants or common weeds in various places. Descriptions are given of the 26 species taken, with records of their food-plants and the localities in which they were found. Those observed on cultivated plants included *Pseudococcus citri*, Risso, on potato, tomato, water-melon and ground-nut (*Arachis hypogaea*), *Trionymus masrensis*, Hall, on barley, *Ripersia internodia*, Hall, on maize, and *Phenacoccus hirsutus*, Green, on beans and ground-nut. Infestation of the roots of plants by *P. hirsutus*, which is generally aerial, occurs when they are growing under heavily infested trees; it is, however, uncommon on those of cotton growing under severely attacked sunt trees [*Acacia arabica*]. The only direct measure of control of root-infesting Coccids is soil fumigation [*cf. loc. cit.*], but cultural methods, including the eradication of weeds and grasses, are often helpful.

The Eucalyptus Snout-beetle in Rhodesia.—*Rhod. agric. J.* **37** no. 4 p. 185. Salisbury, 1940.

Gonipterus scutellatus, Gylh., the larvae and adults of which attack the foliage of *Eucalyptus*, was first observed in the Union of South Africa in 1916, and is thought to have been introduced accidentally from Australia 10 years previously. In 1926, the egg parasite, *Anaphoidea nitens*, Gir., was introduced against it, and recently both host and parasite have been recorded from a locality in the west of Southern Rhodesia. Since both were observed in southern Nyasaland in 1937 [*R.A.E.*, A **26** 203, 204], it is probable that they spread from South Africa through Rhodesia and that other plantations in Southern Rhodesia are affected.

Pescott (R. T. M.). **Insect Pests of Tomatoes. Control Measures.**—*J. Dep. Agric. Vict.* **38** pt. 3 pp. 140–152, 19 figs., 9 refs. Melbourne, 1940.

An account is given of the bionomics and control of the more important pests of tomato in Victoria, together with a key for their identification based on the nature of the damage caused and brief notes on the appearance of the various stages. Cutworms often cause severe losses to summer crops and attack young plants soon after planting. The larval stage lasts 4–6 weeks, and there are usually 2

generations a year. Control consists in eliminating weeds in the spring and the use of a poison bait [*R.A.E.*, A **27** 390]. Tomatos are also attacked by adults of *Listroderes obliquus*, Klug (*costirostris*, auct.), which mainly injure the young plants, cutting through the stems at ground level. The larvae are usually present during late autumn and winter and most commonly attack turnips, carrots, beet and parsnips. Recommendations for control comprise the destruction of weeds prior to planting, and treating the plants in the field, when the first sign of damage is noticed, with a dust containing either 25 per cent. lead arsenate or 20 per cent. calcium arsenate, or a spray of lead arsenate (1 lb. to 16 gals. water). The treatment should be repeated if necessary. Dipping young tomato plants into the suspension of lead arsenate before planting checks cutworms and also controls *L. obliquus*. In northern Victoria, a watch should be kept for *Gnorimoschema* (*Phthorimaea*) *plaesiosema*, Turner, which has not yet been recorded in this State, but is present in New South Wales. Notes on its bionomics and control are given [**20** 167]. *Epilachna vigintioctopunctata*, F. [*cf.* **25** 711] has not yet spread to the tomato-growing areas of Victoria.

The Pentatomid, *Nezara viridula*, L., has spread over the greater part of northern Victoria since 1936; it is chiefly a pest of tomatos and beans, but also attacks potatos, peas and cucurbits. It causes the young shoots to wither and die, and discolours the fruits, in which small corky areas appear at the points of attack. The adults overwinter in sheltered situations and begin to feed and oviposit on the leaves early in spring. The newly hatched nymphs remain clustered round the egg-mass for a day or two before feeding. The complete life-cycle lasts 5–8 weeks. Control measures comprise clean cultivation, and dusting with pyrethrum either alone or mixed with an equal quantity of a 5 per cent. nicotine dust. Dusts should be applied early in the season to kill the nymphs. The Lygaeid, *Nysius vinitor*, Bergr., usually causes serious damage to tomatos only during hot, dry summers, when it appears in large numbers, at first on weeds and in grassland, and later on tomatos, beans, potatoes and orchard fruits. Damage to tomato plants consists in wilting of the foliage and crinkling and discoloration of the fruits. Adults overwinter under rubbish and weeds; and the eggs are laid either on the foliage or flowers of plants, particularly weeds, and hatch in about 6 days. If the adults are numerous, it is practically impossible to control them, but they can be driven from crops by smudge fires. Effective control of the nymphs can be obtained early in the season by a dust of equal parts of pyrethrum powder and a 3 per cent. nicotine dust, or one containing 7 per cent. creosote and 3 per cent. nicotine. Owing to the rapidity with which *N. vinitor* breeds, several applications are necessary. Clean cultivation and the destruction of weeds are essential. *Thrips imaginis*, Bagn., also becomes a serious pest of tomato only during very hot dry seasons. The chief injury is caused to the flowers, though the larvae sometimes weaken the plants by feeding on the foliage. This thrips can be controlled by dusting with pyrethrum or with a 5 per cent. nicotine dust, applications being made every two days while infestation is severe.

Heliothis armigera, Hb. (*obsoleta*, F.) is the most serious pest of tomato fruits in Victoria and causes losses of up to 50 per cent. of the crop. The larvae enter at the stem end of the fruit, so that little damage is visible from the outside. A single larva often travels from

one tomato to another until all the fruits in a bunch are injured. Larvae attacking the plant at flowering time may completely destroy the buds and flowers so that no fruit is set, and they occasionally attack the leaves, causing damage similar to that by cutworms. The pupae overwinter in the soil and the adults emerge in spring ; females lay 500–800 eggs singly on the leaves of the food-plant. The egg, larval and pupal stages last 3–4, 14–21 and 14–21 days, respectively, and there are several generations a year. Control is effected by applying a dust containing 50 per cent. lead arsenate or a spray of 2 oz. lead arsenate and 1 oz. calcium caseinate spreader in 4 gals. water at intervals of 7–10 days, beginning shortly before flowering. If treatment is to be continued up to harvest, the fruits should be wiped or washed, or a nicotine dust should replace lead arsenate 3 weeks before picking. Tomatos that have been injured by *Heliothis* or other insects often become infested with larvae of *Lonchaea aurea*, Macq., but it is not a primary pest, as it cannot oviposit in sound fruits.

The tomato mite, *Phyllocoptes lycopersici*, Massee, although primarily a glasshouse pest, occasionally infests tomatos in the open, particularly in northern Victoria. The mites collect on the surface of the plant in large numbers, and infestation may occur at any stage of growth. They are first abundant on the lower part of the main stems and adjacent leaf stalks, and later migrate to the leaves and branches and finally to the fruits [*cf.* **22** 378 ; **24** 211]. In glasshouses where two crops are grown in quick succession, infestation is usually carried over from one to the other. Development is rapid, and a small initial infestation may become acute within a few weeks. Control measures should not be delayed until symptoms of injury appear ; those recommended comprise fumigation (in glasshouses) or spraying with nicotine sulphate [**26** 46], dusting with a mixture of fine sulphur and hydrated lime [**27** 187] or with 2½ per cent. nicotine, and fumigation with hydrocyanic acid gas generated from sodium cyanide at the rate of 0·1–0·25 oz. per 1,000 cu. ft., or from calcium cyanide.

The introduced Aleurodid, *Trialeurodes vaporariorum*, Westw., thrives under greenhouse conditions in Victoria and has caused serious injury to tomatos. The fruits and leaves are covered with a sticky secretion that forms a medium for the growth of sooty moulds. The larvae hatch in 2–3 weeks and feed on the leaves for 3–4 weeks. In northern Victoria, this Aleurodid occasionally occurs on tomatos in the field. It is controlled by fumigation with either hydrocyanic acid gas or nicotine (as for *P. lycopersici*), by applications at fortnightly intervals in spring and summer of a 2½ per cent. nicotine dust during the warmer part of the day (if possible when the temperature is 75°F. or over), or by spraying the plants, as often as they become infested, with nicotine sulphate and white oil (1 : 6 : 800). The introduced parasite, *Encarsia formosa*, Gah. [*cf.* **25** 677 ; **26** 582] has given very satisfactory control of *T. vaporariorum* in Victoria.

VAN DER VECHT (J.). **De kleine pepersnuitkever** (*Lophobaris piperis* **Marsh.).** [The Small Pepper Weevil.]—*Landbouw* **16** pp. 323–366, 7 figs., 19 refs. Buitenzorg, 1940. (With a Summary in English.)

The lesser pepper weevil, *Lophobaris piperis*, Mshl. [*R.A.E.*, A **19** 1] is widely distributed on pepper (*Piper nigrum*) in the Netherlands East

Indies. It has sometimes been confused with *L. serratipes*, Mshl., which appears to occur only on pepper vines previously weakened by disease [**19** 516]. An account is given of observations on its bionomics in Banka in 1930–31 and subsequently in Java, Sumatra and Borneo, together with descriptions of all stages. The eggs are deposited singly in the nodes of both climbing and flowering shoots, and the larva bores a superficial tunnel round the node and then works to the centre of the branch. The climbing branches are weakened or killed, and continuous injury to the flowering shoots results in serious crop reduction. The larvae moult three times and pupate in cocoons of woody fibres in their tunnels. The adults become active in the late afternoon, but shelter from the sun during the day. When disturbed, they do not fly, but drop to the ground. They feed on the flowers, bore into the fruits and occasionally attack the young shoots. In breeding experiments in the laboratory, the egg and pupal stages averaged 7 and 10 days, the period of larval activity and that spent in the cocoon before pupation 21 and 7 days, and the period spent by the adult in the cocoon 11 days, but in the field complete development required 68–167 days, the larval stage lasting about 40–120. Adult longevity averaged 12 months for males and 16 for females. Females oviposited for about 14 months and laid an average of 377 eggs at the rate of 1–3, or occasionally 4, per day. The Mantok variety of *Piper nigrum* was more severely damaged than the Lampong variety. The only other plant attacked by *L. piperis* is *Piper betle*, but the injury to it is slight.

The parasites observed were a Eulophid of the genus *Euderus*, and the Pteromalid, *Dinarmus coimbatorensis*, Ferrière, which attack the young larvae, the Braconid, *Spathius piperis*, Wlkn., which parasitises larvae in the second, third and fourth instars, and the Eupelmid, *Eupelmus curculionis*, Ferrière, which attacks the larvae in their cocoons. Brief descriptions of the adults of these parasites are given, with notes on their biology and distribution in the Netherlands Indies. Data on percentages of parasitism are tabulated from material from infested branches collected in the field, but the author believes the actual percentages to be considerably higher. The measures recommended for control are the use of healthy cuttings ; the removal of infested climbing shoots of young plants ; collection of the adults in the early morning by jarring them from the branches on to a white cloth ; and the destruction of abandoned gardens, which may become a source of infestation of new plantations. Sprays of lead arsenate or similar insecticides are inadvisable, as pepper is very susceptible to injury by them.

UCHIDA (Toichi). **Schmarotzer von** *Grapholitha glycinivorella*. [Parasites of *Cydia glycinivorella*.]—*Insecta matsum.* **14** no. 2–3 pp. 63–66, 4 figs. Sapporo, 1940.

A list is given of the hitherto known Hymenopterous parasites of *Cydia* (*Grapholitha*) *glycinivorella*, Mats., a serious pest of soy beans in Japan, Korea and Manchuria, showing their other hosts and the countries in which they occur, and two additional species are recorded. One of these is *Pristomerus chinensis*, Ashm., which was reared from larvae of *C. glycinivorella* in Manchuria. It is also parasitic on *C. molesta*, Busck, and occurs in Japan, Korea and China. Characters distinguishing it from *P. vulnerator*, Panz., are given, and it is stated

that *P. vulnerator* f. *erythrothoracis*, Uch., is a form of it [*cf. R.A.E.*, A **21** 548]. The other is described as *Hemiteles* (*Microtorus*) *tenuibasalis*, sp. n., from females reared from larvae of *C. glycinivorella* in Hokkaido. The male is unknown. It is closely allied to the species described as *H.* (*Rhadiurgus*) *chrysopae*, Uch. [**22** 48], for which the new name *H.* (*M.*) *kichijoi* is proposed as it is preoccupied by *H. chrysopae*, Brischke.

WATANABE (C.). **Hymenopterous Parasites of the Mulberry Pyralid Moth, *Margaronia pyloalis* Walker, in Japan (I).**—*Insecta matsum.* **14** no. 2–3 pp. 85–94, 3 figs., 8 refs. Sapporo, 1940.

Records are given of eight parasites of the mulberry Pyralid, *Margaronia pyloalis*, Wlk., in Japan, with descriptions of some of them and notes on their other hosts and distribution. In addition to the four noticed in a previous paper [*R.A.E.*, A **28** 263], they comprise the Ichneumonid, *Spilocryptus japonicus*, Uch., and the Braconids, *Chelonus tabonus*, Sonan, *Apanteles minor*, Ashm., and *A. kurosawai*, sp. n. Unlike *A. minor*, the new species is a solitary parasite ; it is described from both sexes reared from *M. pyloalis* in Honshu. *A. minor* is also recorded from the same host in Formosa.

HOLDAWAY [F. G.] & others. **Entomology.**—*Rep. Hawaii agric. Exp. Sta. 1939* pp. 36–42. Honolulu, 1940.

An account is given of observations on insect pests of crops in Hawaii in 1938–39. Studies on the Capsid, *Engytatus geniculatus*, Reut. (*Cyrtopeltis varians*, Dist.) on tomato [*cf. R.A.E.*, A **26** 214] in greenhouses under cage conditions indicated that the attack is mainly on the stems, petioles and veins, and that oviposition also occurs in these parts but in separate punctures. Feeding scars appear about 40 hours after attack begins, and scar formation increases with the appearance of the first nymphs. Damaged plants are bushy, with swollen nodes and short internodes, while the date of first fruiting is delayed and the yield reduced. This Capsid is also predacious [*cf.* **26** 214 ; **27** 251] and attacks Aphids, mealybugs and nymphs of its own species. Although the incidence of virus disease was high in regions in which *E. geniculatus* was found, there is no evidence that it transmits a virus. Field observations suggest that its prevalence is correlated with a hot dry climate, a decrease in temperature and an increase in moisture being followed by a reduction in numbers. Plants are not attacked until after transplanting, when they are 6–8 ins. high and the first flower buds are appearing. The numbers of nymphs and adults increase until 9 12 weeks after transplanting. Tomato is the only plant on which prolific breeding and high populations have been observed in Hawaii, but the Capsid also breeds on tobacco, egg-plant [*Solanum melongena*], potato, squash, and ornamental geranium and *Plumbago*. No predators or parasites have been recorded in Hawaii.

As the first phase of a project for the biological control of *Pieris* (*Pontia*) *rapae*, L., on cabbage, a survey was made of the parasites already present, their distribution and the degree of parasitism by each, 1,316 larvae and 223 pupae being examined from 17 collections made on 5 islands. The parasites obtained were *Apanteles glomeratus*, L., *Achaetoneura* (*Frontina*) *archippivora*, Will., *Brachymeria obscurata*,

Wlk., *Hyposoter exiguae*, Vier., and *Pteromalus puparum*, L. *B. obscurata* was obtained from only five individuals, *P. puparum* from two and *H. exiguae* from one. *A. archippivora* was recorded from all except one collection, the percentage parasitism by it ranging from 1 to 22 and averaging 8. This Tachinid is primarily a parasite of army worms. The most important was *A. glomeratus*, which was present on all the islands surveyed and occurred from sea level up to elevations of 4,000 ft. The percentage parasitism by it ranged up to 74, and was lowest on farms where insecticides were used. Parasitism by *A. archippivora* was little, if at all, affected by insecticides.

In view of the recent appearance of a virus disease of papaya in Hawaii and the increasing importance of this fruit for local consumption and export, a study of insects occurring on papaya was made ; so far, 49 species in 28 families have been recorded, but only a few of them are major pests of papaya. The sporadic occurrence of the disease suggests, however, that the vector may be a casual visitor. Transmission experiments were conducted with most of the recorded species considered likely to be vectors, as well as some known to transmit virus disease in Hawaii although not yet recorded on papaya, with negative results. These included *Nysius coenosulus*, Stål, *Thrips tabaci*, Lind., the Aphids, *Aphis gossypii*, Glov., *Macrosiphum solanifolii*, Ashm. (*gei*, auct.), *Myzus persicae*, Sulz., and *Aphis medicaginis*, Koch, and the Jassid, *Empoasca solana*, DeLong, all of which have been taken on papaya, and *Aphis maidis*, Fitch, the vector of sugar-cane mosaic, some of the symptoms of which resemble those observed on papaya. Heavy infestations of *M. persicae* produced symptoms similar to those characteristic of the disease.

Insects that have recently caused damage to crops include the Criocerid, *Lema nigrovittata*, Guér., of which the larvae and adults feed on the foliage of *Datura* and which has also been recorded on egg-plant on Oahu and Hawaii ; *Listroderes obliquus*, Klug, which was first recorded in Hawaii in 1926, and in 1939 attacked various vegetables, particularly cabbage and carrots, serious losses occurring in regions having a cool, moist climate and an elevation of about 2,700 ft. ; and *Maruca testulalis*, Geyer, which caused serious damage to lima beans and climbing green snap beans in hot, dry regions on Oahu and may be responsible for much of the injury previously attributed to *Cosmolyce* (*Lycaena*) *boetica*, L. *Murgantia histrionica*, Hahn, first recorded in Hawaii in 1917 and in 1923 found breeding on *Capparis sandwichiana*, was taken in 1938-39 on several varieties of cabbage in a hot dry district on Oahu. The distribution of this Pentatomid in temperate regions of the United States suggests the possibility of its becoming a serious cabbage pest in Hawaii. *Solenopsis geminata*, F., damaged young plants of tomato, egg-plant and cucumber, also in hot, dry regions of Oahu. Notes on miscellaneous pests of crops in Hawaii are summarised in a table.

PERROTTET [G. S.] & GUÉRIN-MÉNEVILLE [F. E.]. **Le *Leucoptera coffeella* et sa découverte à la Guadeloupe.**—*Rev. Bot. appl.* **20** no. 223 pp. 193–201, 2 figs. Paris, 1940.

This is a reproduction of parts of a memoir published in Paris in 1842 by the authors under the title " Mémoire sur un insecte et un champignon qui ravagent les Caféiers aux Antilles," recording the discovery of *Leucoptera coffeella*, Guér., on coffee in Guadeloupe.

HAYWARD (K. J.). **El pulgón verde de los cereales** (*Toxoptera graminum* **Rondan**). [The Green Cereal Aphis.]—*Circ. Estac. exp. agríc. Tucumán* no. 87, 4 pp., 1 fig., 4 refs. Tucumán, 1940.

Toxoptera graminum, Rond., which has already been recorded as a pest of cereals in other parts of Argentina [*R.A.E.*, A **25** 631; **26** 30, 289], destroyed about 90 acres of oats in Tucumán in June 1940, and was subsequently found on experimental plots of oats and barley. A brief description of the adults of this Aphid is given, with notes on the injury done by it, its natural enemies, and the measures to be taken against it [**25** 631]. Its natural enemies in Tucumán included the Coccinellids, *Eriopis connexa*, Germ., *Cycloneda sanguinea*, L., and *Coccinella ancoralis*, Germ., Syrphid larvae, and the Braconid parasite, *Aphidius platensis*, Brèthes.

MENDES (L. O. T.). **O minador da batatinha** *Agromyza brasiliensis* **Frost (1939) (Diptera, Agromyzidae).** [The Potato Miner, *A. braziliensis*.]—*Bol. téc. Inst. agron. Campinas* no. 78. Repr. from *Jorn. Agron.* **3** no. 3 pp. 207–220, 3 pls., 4 refs. S. Paulo, 1940. (With a Summary in English.)

In June 1937, potato tubers in São Paulo, Brazil, were found to be infested by larvae of an Agromyzid subsequently described by S. W. Frost as *Agromyza braziliensis*, sp.n. [*Ent. News* **50** 97, 1939]. Descriptions are given of the larva and pupa, with a re-description of the adults. The eggs are believed to be laid under the skin of the tuber, and the larvae mine between the skin and the pulp. This Agromyzid is not an important pest and is parasitised by a Miscogasterid of the genus *Halticoptera*.

LAMBERT (R.) & GENEST (M. E.). **Les insectes forestiers du Québec en 1939.**—*Bull. Serv. Ent. Minist. Terres Québec* no. 4, 38 pp. multigr., 1 pl., 1 fldg map. Québec, 1940.

The survey of insect pests of forests in Quebec [*cf. R.A.E.*, A **27** 463] was considerably extended in 1939 and covered nearly 200,000 sq. miles. Almost 3,000 samples comprising 120,500 individuals were collected, and the results are shown in tables and discussed.

Gilpinia (*Diprion*) *polytoma*, Htg. [*cf.* **28** 515] was again the most serious pest of spruce and comprised 65 per cent. of all the insects collected. The average number of larvae per tree, which was 44 in 1938, rose to 53 in 1939. It occurred in nearly all districts and even extended a little to the north of latitude 50° N. It was not recorded in the Gatineau valley, where a few examples were observed in 1938 [*cf.* **27** 464]. The introduced parasite, *Microplectron fuscipenne*, Zett., millions of which are liberated each year, increased rapidly in several districts. *Neodiprion abietis*, Harr., and *Pikonema dimmocki*, Cress., were often associated with *G. polytoma* on spruce, but though widespread they were not epidemic. *P. alaskensis*, Rohw., was also widely distributed on spruce, especially young or ornamental trees, on which the larvae can easily be destroyed by spraying with 1 lb. calcium arsenate in 20 gals. water. *Cephaleia* sp. was commoner on spruce than in 1938, but not sufficiently abundant to be harmful.

The Geometrid, *Semiothisa granitata*, Gn., was fairly common on spruce, larch and fir [*Abies*], but no increase was observed in the numbers of *Ellopia fiscellaria*, Gn., on spruce and fir. *Chermes* (*Adelges*) *abietis*, L., injured spruce in some districts, and *Pristiphora erichsoni*, Htg., occurred in all important larch forests, defoliating up

to 60 per cent. of the trees in some localities. Parasitism of the cocoons by *Mesoleius tenthredinis*, Morl., amounted to 30 per cent. in one locality. A Tachinid, *Ptychomyia* (*Bessa*) *selecta*, Mg., was also an effective parasite. Another sawfly, *Anoplonyx laricis*, Marl., caused damage to larch in some districts, while *Neodiprion lecontei*, Fitch, and *N. pinetum*, Norton, were again found on pine, and birch was defoliated in some areas by *Arge pectoralis*, Leach.

The severe outbreak of *Malacosoma disstria*, Hb., on deciduous trees near Lake Megantic was terminated at the beginning of the summer by a bacterial disease that killed the young larvae, which were abundant early in May. *Pissodes strobi*, Peck, caused considerable injury to white pine [*Pinus strobus*] and also attacked young Norway spruce [*Picea abies*]. The trunks of spruce were attacked by another weevil, *Hylobius* (*Hypomolyx*) *piceus*, DeG., which causes considerable damage, appears to be increasing in numbers, and has a 2-year life-cycle. In some districts the Tortricid, *Rhyacionia* (*Petrova*) *albicapitana*, Busck, severely infested grey pine [*Pinus banksiana*].

Balch (R. E.). **The Spruce Sawfly Outbreak in 1939.**—*Pulp Pap. Mag. Canada* February 1940 repr. 5 pp., 1 map, 5 refs. Montreal, 1940.

Though the spruce sawfly known as *Gilpinia polytoma*, Htg., in eastern Canada is almost certainly of European origin [*cf. R.A.E.*, A **27** 647], the author considers that in view of the differences in its biology and chromosome numbers [**26** 215] and of work on its morphology [**26** 247], it represents an undescribed species. The course of the outbreak, the resultant injury to spruce, and the natural control exerted during 1939 are described [*cf.* **28** 515], and the known distribution of the sawfly in eastern Canada and the United States in that year is shown on a map. There was little change in the area or degree of infestation, and it is probable that the range of the sawfly is now fairly accurately known. It occurred in small numbers on Anticosti Island for the first time, but was apparently not present in Newfoundland. Infestation became severe north of the St. Lawrence and in parts of northern and eastern Maine; in New Hampshire [*cf.* **28** 339] and Vermont, the heavily infested areas increased in size, leaving the original focus comparatively lightly infested, and a similar phenomenon occurred in New Brunswick, though in a less striking degree. Mortality of the trees is still practically confined to the Gaspé Peninsula, where the total mortality of white and black spruce [*Picea glauca* and *P. mariana*] is about 73 and 43 per cent. by volume [*cf.* **27** 368]. Of this, 47 per cent. of *P. glauca* and 6 per cent. of *P. mariana* was attacked, chiefly during 1932–34, by *Dendroctonus piceaperda*, Hopk. [*cf.* **23** 236; **27** 369], which was less numerous in 1939 than in the previous year. Nearly all the dying trees were attacked by secondary beetles. In the more southerly districts, greater fluctuations in the numbers of the sawfly are likely, owing to the longer, warmer season and reduced diapause. High populations are followed by a scarcity of old foliage [**26** 487], resulting in considerable reduction by starvation, increased mortality due to disease, and probably reduced oviposition. Black spruce and red spruce [*P. rubra*] are unlikely to be killed by the first severe attack and, provided that succeeding sawfly populations are maintained at a low level, only weak trees succumb, but the initial mortality among

P. glauca is more likely to be high owing to the ability of the larvae to survive on young foliage [**26** 487].

During 1939, the temperature was lower than normal until June and higher during July and August. In general, rainfall was below the average until June and also during July and August in the southern part of the infested area, including central and southern New Brunswick, where there are two generations a year ; in the northern part, where there is only one generation, the rainfall was heavy in July and August. These conditions tended to reduce and delay emergence, and caused more larval mortality than usual in some districts.

The progress of the outbreak was checked over considerable areas, especially in the southern section, by a disease that attacked the feeding larvae in certain districts. It has occurred for several years under laboratory conditions, but did not appear in the field until 1938. In 1939, it became of considerable importance in the southern section and was first observed during the latter part of the first generation, when a considerable number of the larvae had spun cocoons ; in some places most of the larvae present after the end of July became diseased, and the second generation was accordingly considerably reduced. It was in general less important in the north. It has the characteristics of a virus infection ; infected larvae become pale, then dark and flabby, and die within a day or two. They can be distinguished from other dead larvae by their black colour. The factors governing the incidence of the disease are not understood, but fairly high temperatures and population densities appear to be favourable. In the Gaspé Peninsula, where the climate is cooler and very few larvae were naturally infected, larvae on trees that were sprayed with an extract of diseased larvae became highly infected. The percentage of cocoons infested by native parasites was again less than 0·02, and the number destroyed by mice and shrews, which appeared to be more numerous than usual, was only slightly increased.

Large-scale liberations of the introduced cocoon parasite, *Microplectron fuscipenne*, Zett., were continued throughout most of the infested area ; this Eulophid is well established throughout the greater part of New Brunswick and Quebec south of the St. Lawrence, and is able to survive under all the prevailing conditions. There was a considerable increase in its numbers during 1939 in central and southern New Brunswick, where the percentage parasitism averaged between 13 and 30, and reached 45 in one district. It was present in all of the 70 scattered localities at which collections were made, generally occurring in more than 10 and often in more than 25 per cent. of the sound cocoons. In two plots set aside for the investigation of sawfly populations, the percentage parasitism increased from 0·8 and 0·2 in 1938 to 14 and 5 in 1939. In August, 23 per cent. of a total of 707 sound cocoons collected from beneath 3 trees 6 7 miles distant from a place where a small liberation had been made in the previous year were parasitised. The success of *M. fuscipenne* in this part of the infested area is attributed to its ability to produce 4 generations a year there, to attack cocoons buried as deep as 3 ins. beneath moss and débris, and to enter the winter in the white pupal stage, which is the one most resistant to prevailing winter conditions ; to the presence of colonies comprising both sexes within a single cocoon, which favours survival in light infestations ; and, in 1939, to favourable weather conditions. The occurrence of disease among the host larvae reduced the number of cocoons formed in the autumn after parasite oviposition

had ceased. In northern New Brunswick and Quebec, where less extensive surveys were made, the highest percentage of parasitism observed was 6, but evidence was obtained of an increase in some districts, although in others there may have been a decrease. These less satisfactory results are probably due partly to the heavy summer rainfall in 1939 and to the cooler climate and shorter season, in which fewer generations are produced, but other factors may also be involved.

The introduced species of *Exenterus* previously referred to as *adspersus*, Htg. [*cf.* **27** 369] is the only other parasite to exert definite control [*cf.* **28** 515]. In 1939, 36 per cent. of the healthy mature larvae that descended from the trees in a stand near a point in central New Brunswick, where a small release was made in 1936, bore eggs of this Ichneumonid, and adult parasites emerged from 52 per cent. of the cocoons constructed by larvae from two trees at the liberation point. At distances of 4 and 2 miles from this point, 1 and 6 per cent., respectively, of the cocoons in the ground that were examined in autumn were parasitised by *Exenterus*. In the south, this species produces two generations a year, and considerable mortality resulted in 1939 from the reduction in numbers by disease of the sawfly larvae of the second generation, in which the parasite population had chiefly increased in 1938. *Exenterus* overwinters in the larval stage, and is now sufficiently abundant for redistribution to be made from material collected in Canada.

Although the important checks to the progress of the outbreak provided by weather conditions, disease and parasites in 1939 offer encouraging prospects and have reduced the danger of serious destruction to spruce outside the Gaspé area in the immediate future, large populations of the sawfly still exist, and the work of surveying and liberating parasites should not be relaxed.

DeLong (D. M.), Waters (H. A.) & Witman (E. D.). **Basic Copper Arsenate : A new Insecticide for Bean and Potato Pests.**—*Proc. Ohio Veg. Potato Growers Ass.* **24** pp. 86–92, 2 figs. 1939. (Abstr. in *Exp. Sta. Rec.* **82** no. 4 p. 510. Washington, D.C., 1940.)

The results are given of experiments with basic copper arsenate, Cu ($CuOHAsO_4$), against pests of beans and potatoes in Ohio. When used as a spray, it gave complete control of larvae of the Mexican bean beetle [*Epilachna varivestis*, Muls.] in 24 hours, both in the field and in the laboratory, at a concentration of 1 lb. per 100 U.S. gals., but one of 3 lb. per 100 U.S. gals. was necessary to control the adults, as is also the case with calcium arsenate or lead arsenate. Similar results were obtained against the Colorado potato beetle [*Leptinotarsa decemlineata*, Say]. A dust containing 25 per cent. basic copper arsenate gave excellent control of both these beetles, and was highly repellent to the potato leafhopper [*Empoasca fabae*, Harr.], affording protection to the plant for several days after application. Basic copper arsenate was more toxic to larvae of the southern armyworm [*Laphygma eridania*, Cram.] than acid lead arsenate. Its low phytotoxicity can be correlated with its low water-soluble arsenic value as determined by the air-bubble test and its stability in the presence of such chemicals as weak acids, salts, etc. It has the lowest soluble-arsenic figure of any effective arsenical insecticide tested, and has proved to be the safest of all the arsenicals when applied to plant foliage.

Hoffmann (C. H.). **Additions to annotated Lists of Insects reared from Elm Bark and Wood.**—*Bull. Brooklyn ent. Soc.* **35** no. 2 pp. 54–63, 2 refs. Brooklyn, N.Y., 1940.

This annotated list of insects taken in the United States in the course of work on vectors of the fungus, *Ophiostoma* (*Geratostomella*) *ulmi*, causing Dutch elm disease, is confined to species actually breeding in elm bark and wood and those associated with them. Insects included in the lists by Pechuman and Kaston [*R.A.E.*, A **25** 520 ; **26** 725] are omitted unless the original records were made by workers of the Morristown laboratory. The list comprises 66 Coleoptera, 12 Hymenoptera (chiefly parasites) and 11 species belonging to other Orders.

Autuori (M.). **Um novo processo de combate à "sauva."** [A new method of combating Leaf-cutting Ants.]—*Biologico* **6** no. 9 pp. 270–272, 1 fig. S. Paulo, 1940.

A description is given of a tool consisting of a metal rod 6–9 ft. long and ½ in. in diameter to the lower end of which is screwed a tip of solid metal of which the diameter is greater at the bottom than at the top. It is used for making holes in the ground for applying fumigants such as carbon bisulphide to the nests of leaf-cutting ants [*Atta sexdens*, L.] in São Paulo, Brazil. The tool makes a hole of a diameter wider than that of the rod, so that friction is minimised and water can be poured in to facilitate insertion. A series of holes are made into the nest, the fumigant is introduced and the holes are then closed.

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Wille (J. E.). **El "perforador pequeño de la bellota del algodonero," *Mescinia peruella*, Schaus.** [The Small Boll-borer of Cotton, *M. peruella*, in Peru.]—*Bol. Estac. exp. agríc. La Molina* no. 19, 33 pp., 5 pls., 11 refs. Lima, 1940. [*Cf. R.A.E.*, A **23** 16.]

Kôno (H.). **Eine neue *Rhynchites*-Art, schaedlich an Yezofichten in Hokkaido.** [A new Species of *Rhynchites*, *R. haradai*, sp. n., harmful to *Picea jezoensis* in Hokkaido.]—*Insecta matsum.* **14** no. 2–3 pp. 67–68, 1 fig. Sapporo, 1940.

Ishii (T.). **A new Chalcidoid-wasp** [*Catolaccus endonis*, sp. n.] **reared from *Anthonomus bisignifer* Schenkling** [in Japan].—*Insecta matsum.* **14** no. 2–3 pp. 83–84, 1 fig. Sapporo, 1940.

Watanabe (C.). **A Braconid Parasite** [*Microplitis theretrae*, Watanabe] **of *Theretra japonica*, de l'Orzo** [in Japan] **(Host Record of Braconidae, III).**—*Insecta matsum.* **14** no. 2–3 p. 94. Sapporo, 1940.

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